MAG 2007 FIVE PERCENT PLAN FOR PM-10 FOR THE MARICOPA COUNTY NONATTAINMENT AREA

APPENDICES

VOLUME THREE

DECEMBER 2007

MARICOPA
ASSOCIATION of
GOVERNMENTS

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TECHNICAL DOCUMENT

IN SUPPORT OF THE

MAG 2007 FIVE PERCENT PLAN FOR PM-10
FOR THE MARICOPA COUNTY NONATTAINMENT AREA

December 2007

Maricopa Association of Governments
302 North 1st Avenue, Suite 300
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I. INTRODUCTION

The U.S. Environmental Protection Agency (EPA) published a final notice on June 6, 2007 that the Maricopa County PM-10 Nonattainment Area had failed to attain the 24-hour PM-10 standard by December 31, 2006. Section 189(d) of the Clean Air Act requires Serious nonattainment areas that do not meet the applicable attainment date to prepare a plan that reduces PM-10 emissions by at least five percent per year until the standard is attained at the monitors. The Clean Air Act specifies that the plan must be based on the most recent emissions inventory for the area and must also include a modeling demonstration of attainment.

The 2005 Periodic Emissions Inventory for PM-10 for the Maricopa County, Arizona, Nonattainment Area (PEI) is the most recent emissions inventory for the area. Documentation of the PEI is provided in Appendix B, Exhibit 1, of the Five Percent Plan. After review by EPA and other members of the Air Quality Planning Team, MAG finalized the Modeling Protocol in Support of a Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area on September 29, 2006 (Appendix I). In general, the attainment demonstration modeling performed for the Salt River and Higley areas follows the approaches documented in this protocol.

The Technical Support Document in Support of the MAG 2007 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area (TSD) describes the base case emissions inventories, the quantification of committed control measures that meet the five percent and contingency measure requirements, and the modeling that demonstrates attainment in the PM-10 nonattainment area.

The TSD describes the development of the 2007-2010 emissions inventories that are based on the most recent emissions inventory for the area. The projection of the 2005 periodic emissions for the PM-10 nonattainment area to 2007, 2008, 2009, and 2010 and the resultant base case emissions inventories are documented in Chapter II of the TSD. Chapter III describes the methods and assumptions that were applied to quantify committed control measures to meet the annual five percent requirement of the Clean Air Act. Chapter IV describes the methods and assumptions used to quantify control measures to meet the contingency requirements of the Clean Air Act.

Chapter V documents the dispersion modeling that was performed to demonstrate attainment in the Salt River Area. The Salt River Area modeling relies heavily on data collected by the MAG PM-10 Source Attribution and Deposition Study. The purpose of the study was to identify the sources of emissions contributing to violations of the PM-10 standard during stagnant meteorological conditions and characterize the deposition of PM-10 particles emitted by these sources. The study conducted sampling of new meteorological and particulate matter data in the Salt River area between November 15 and December 14, 2006. The monitoring tools used by the study included a particle lidar, mobile monitoring, DustTrak optical monitors, an aerodynamic particle size analyzer, MiniVol filter based samples, a sodar, and a SCAMPER vehicle. The SCAMPER (System for Continuous Aerosol Monitoring of Particulate Emissions from Roadways) was used to measure PM-10 from paved roads. Chapter V discusses the data from this study that was used to model attainment for the Salt River Area.

Chapter VI describes the modeling that demonstrates attainment in the area surrounding the Higley monitor. A proportional rollback model was applied to show that the area would attain the standard with both existing and projected land uses.

A supplemental analysis was also performed to demonstrate attainment at other monitors in the PM-10 nonattainment area. This simplified rollback approach and the results of the analysis are described in Chapter Eight of the Five Percent Plan.

II. BASE CASE PM-10 EMISSIONS INVENTORIES

Section 189(d) of the Clean Air Act requires that the plan provide, from the date of submission until attainment, an annual reduction in PM-10 emissions of not less than five percent of the emissions in the most recent inventory prepared for the area. The Five Percent Plan for the Maricopa PM-10 nonattainment area provides reductions of five percent per year in the most recent 2007 emissions inventory, from the date of submission, December 31, 2007, to the attainment date of December 31, 2010. This chapter describes the development of the base case 2007 PM-10 emissions inventory, as well as the projected base case inventories for 2008-2010.

In May 2007, the Maricopa County Air Quality Department finalized the 2005 Periodic Emissions Inventory for PM-10 for the Maricopa County, Arizona, Nonattainment Area (PEI) (Appendix B, Exhibit 1). In general, growth factors have been applied to the 2005 PEI emissions to project 2007, 2008, 2009, and 2010 base case emissions for the Five Percent Plan. Most of the growth factors represent the ratio of the growth surrogate (e.g., population, industrial employment) in the projection year to 2005. In a few cases, (e.g., unpaved roads, windblown dust, paved roads), new information became available after the PEI was prepared and the base case PM-10 emissions for 2007-2010 were estimated on the basis of this new information.

The remainder of this chapter documents the derivation of the 2007-2010 base case emissions inventories. The discussion below is organized by source category, i.e., point, area, nonroad mobile and onroad mobile sources. All estimates referred to below represent tons per year of PM-10 emissions in the Maricopa County PM-10 nonattainment area.

POINT SOURCES

Point sources of PM-10 are those permitted sources that emit more than 5 tons per year of PM-10. The PEI estimate of 1,636 tons of PM-10 emissions from point sources was grown from 2005 to 2007-2010 using industrial employment projections for Maricopa County as the growth surrogate. The projections of industrial employment shown in Table II-1 were developed by MAG using socioeconomic models with input data from recent employment surveys, the 2005 Special U.S. Census for Maricopa County, aerial photography, the Maricopa County Assessor's files, and a regional development database.

AREA SOURCES

Area sources of PM-10 emissions include industrial processes that are not large enough to qualify as points sources, fuel combustion, fires, agriculture, construction, travel on unpaved parking lots, off-road recreational vehicles, leaf blower dust, and windblown dust. Each of these sources of PM-10 emissions is addressed individually below.

Table II-1. Residential Population and Industrial Employment for Maricopa County, 2005-2010

	Population and Employment Estimates for Maricopa County							Growth Factors (relative to 2005)			
Growth Surrogate	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**		**2007**	**2008**	**2009**	**2010**
Residential Population	3,681,025	3,788,120	3,895,215	4,002,309	4,109,404	4,216,499		1.06	1.09	1.12	1.15
Industrial Employment	357,712	374,734	391,756	408,777	425,799	442,821		1.10	1.14	1.19	1.24

Industrial Processes

This category includes manufacturing and other industrial activities that do not individually produce enough emissions to qualify as point sources. The 2005 PEI estimate of 3,226 tons of PM-10 emissions from industrial processes, excluding construction, was grown from 2005 to 2007-2010 using the industrial employment projections for Maricopa County (Table II-1). PM-10 emissions from construction sources are projected with other growth factors, as discussed in a later section.

Fuel Combustion

This category includes residential, commercial, and industrial gas, wood, and oil burning. The 2005 PEI estimate of 692 tons of PM-10 emissions from fuel combustion was grown from 2005 to 2007-2010 based on the latest population projections for Maricopa County (Table II-1). The population projections were developed using socioeconomic models with input data from recent employment surveys, the 2005 Special U.S. Census for Maricopa County, aerial photography, the Maricopa County Assessor's files, and a regional development database. The population projections were approved by the MAG Regional Council in May 2007.

Fires

This category includes open burning, wildfires, structure fires and vehicle fires. The PEI estimate of 4,933 tons of PM-10 emissions from fires in 2005 was held constant for 2007-2010. The biggest contributor (98.5 percent) to this category is wildfires, which are not possible to predict or control.

Agriculture

The PEI estimates of PM-10 emissions from agriculture in 2005 include tilling and harvesting (1,288 tons), travel on unpaved farm roads (911 tons), and livestock (521 tons). The growth factors for tilling and harvesting and travel on unpaved farm roads were derived from the trend in acres of agricultural crops in Table II-2, as reported for Maricopa County in the Arizona Agricultural Statistics Bulletins in 2000 through 2004. The 2005 crop acreages were not included in the calculations, because several crop types were missing from the 2005 Bulletin.

The growth surrogate for tilling and harvesting emissions is acres of field crops, excluding grapes and citrus. The acres of crops in 2000 and 2004 were used to develop the average annual rate of change shown in Table II-2. Based on past trends, tilling and harvesting acreage is expected to decline by 4.6 percent per year due to the rapid development of farmland in the PM-10 nonattainment area. Application of this annual decline to the 2004 acreage produces crop acreage in 2007-2010. The 2007-2010 acreage is divided by the 2005 acreage to obtain the growth factors in Table II-3. The growth factors were applied to the 2005 PEI emissions for tilling and harvesting to obtain the 2007-2010 projections.

Table II-2. Trends in Acres of Crops and Head of Livestock in Maricopa County, 2000-2005

Emissions Category	Growth Surrogate	2000	2001	2002	2003	2004	Annual Rate of Change (2000-2004)
Tilling and harvesting	Harvested acres of field crops, excluding citrus and grapes	218,200	202,200	173,200	169,750	180,650	-4.6%
Travel on unpaved farm roads	Harvested acres of field crops, including citrus and grapes	231,800	213,700	183,300	179,050	189,950	-4.9%
Livestock	Head of livestock	181,000	191,000	199,000	217,000	257,000	5.2%

Source for growth surrogate data: 2000-2004 Arizona Agricultural Statistics Bulletins published annually by the United States Department of Agriculture.

Table II-3. Derivation of Growth Factors for Agricultural Emissions

	Annual change applied to 2004 acreage (from Table II-2)							Growth factors relative to 2005			
Emissions Category	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**		**2007**	**2008**	**2009**	**2010**
Tilling and harvesting	172,340	164,412	156,849	149,634	142,751	136,185		0.91	0.87	0.83	0.79
Travel on unpaved farm roads	180,642	171,791	163,373	155,368	147,755	140,515		0.90	0.86	0.82	0.78
	Head of livestock held constant after 2005							**Growth factors relative to 2005**			
Livestock	262,000	262,000	262,000	262,000	262,000	262,000		1.00	1.00	1.00	1.00

Source for 2005 livestock data: 2005 Arizona Agricultural Statistics Bulletin published by the United States Department of Agriculture.

Travel on unpaved farm roads was projected using the same growth surrogate as tilling and harvesting, but with acres of grapes and citrus crops added. The rate of decline in total crop acreage in Maricopa County between 2000 and 2004 was 4.9 percent per year. Application of this annual decline to the 2004 acreage produces estimates of crop acreage in 2007-2010. The 2007-2010 acreage is divided by the 2005 acreage to obtain the growth factors in Table II-3. The growth factors were applied to the 2005 PEI emissions for travel on unpaved farm roads to obtain the 2007-2010 projections.

Table II-2 indicates that the head of livestock in Maricopa County increased by an annual average rate of 5.2 percent between 2000 and 2004. However, this is likely to represent the trend in the two-thirds (approximately 6,000 square miles) of Maricopa County that lies outside of the PM-10 nonattainment area and is predominantly rual. Inside the nonattainment area, new developments are consuming agricultural land at a rapid pace and urban encroachment is expected to discourage livestock farmers from increasing the size of their herds. For these reasons, the 2005 PEI estimate of livestock emissions in the PM-10 nonattainment area is held constant in 2007-2010.

Construction

The 2005 PEI estimates of PM-10 emissions from construction are 11,332 tons for residential construction, 11,086 tons for commercial construction, 7,236 tons for road construction, and 2,476 tons for other land clearing. The other land clearing category includes site preparation, weed control and trenching. Construction activity levels are highly dependent upon the national and regional economy and may fluctuate significantly from year to year. To dampen this volatility, the projection of construction activity for 2007-2010 is based on the average activity over the four-year period, 2004-2007.

The growth factors for construction emissions are based on the acreage reported on earthmoving permits issued by the Maricopa County Air Quality Department (MCAQD) for construction activities in the PM-10 nonattainment area. The 2004-2007 permitted acres were provided by MCAQD on November 15, 2007. The acreage as of September 11, 2007, was extrapolated to the end of the year based on the ratio of the permitted acreage at the end of 2006 to the permitted acreage as of September 11, 2006. The permitted earthmoving acreage data is shown below.

Earthmoving Permit Acreage by Category	2004	2005	2006	2007	Average 2004-2007
Commercial/Industrial	8,073	9,740	12,759	10,748	10,330
Residential	36,738	43,509	39,037	39,865	39,787
Road	2,685	4,199	4,642	3,885	3,853
Other Land Clearing	8,526	6,204	8,548	11,475	8,688
Total Earthmoving Permit Acreage	56,021	63,652	64,986	65,973	62,658

The construction growth factors were developed by dividing the average permit acreage in 2004-2007 by the permit acreage in 2005 for each category. The resultant factors are shown below.

Construction Category	Construction Growth Factors (relative to 2005)
Commercial/Industrial	1.06
Residential	0.91
Road	0.92
Other Land Clearing	1.40

The growth factors above were applied to the PEI emissions estimates for 2005 to project construction emissions by category. Because the growth factors are based on average historical conditions, the base case construction emissions were held constant in 2007-2010.

Travel on Unpaved Parking Lots

The PEI estimate of 3,009 tons of PM-10 generated by travel on unpaved parking lots was grown from 2005 to 2007-2010 based on the population projections for Maricopa County shown in Table II-1.

Off-Road Recreational Vehicles

The PEI estimate of 2,159 tons of PM-10 emitted by off-road recreational vehicles was grown from 2005 to 2007-2010 based on the population projections for Maricopa County shown in Table II-1.

Leaf Blower Fugitive Dust

The PEI estimate of 843 tons of PM-10 generated by leaf blowers was grown from 2005 to 2007-2010 based on the population projections for Maricopa County shown in Table II-1.

Windblown Dust

The PEI estimates of windblown dust emissions were estimated by ENVIRON using the Windblown Dust Model (WDM) and wind speed data for the year, 2005. Since the number of windy days vary considerably from year to year, the volatility and margin of error in the projections can be reduced by using wind speed measurements over a multiple-year period. MAG developed new estimates of windblown dust emissions using wind speed data for 2001-2005. The methodology, also used in the Serious Area PM-10 Plan, is documented in MAG, Windblown Dust Emission Calculations for PM-10 Nonattainment Area for the Years 2001 to 2005 (Appendix II, Exhibit 3). Windblown dust emissions for construction, vacant land, and agriculture were estimated using 2001-2005 wind speed measurements in the PM-10 nonattainment area. Windblown Other emissions were obtained from the WDM estimates used in the 2005 PEI.

Windblown construction, vacant land and agriculture emissions were estimated for the Maricopa County portion of the PM-10 nonattainment area. The 2005 PEI also included windblown emissions for the Pinal County portion of the nonattainment area; the Pinal County windblown emissions were added to the Windblown Other category.

Annual windblown agricultural emissions were estimated on the basis of crop acreage provided by the 2001-2005 Arizona Agricultural Statistics Bulletins. Since the windblown agricultural emissions were averaged over the period 2001-2005, the base year for the growth factors was assumed to be the mid-point year, 2003. The 2007-2010 windblown agriculture growth factors are based on the same surrogate as tilling and harvesting emissions (i.e., 2000-2004 acres of crop land in Maricopa County, excluding citrus and grapes, shown in Table II-2), except that the growth factors were calculated relative to the base year of 2003, instead of 2005.

The base year for windblown emissions for construction and vacant land is 2004, because 2004 land use data was used to estimate these emissions. Windblown dust from alluvial areas is included in the estimate for vacant land.

As indicated in Appendix II, Exhibit 3, control factors were applied to the windblown PM-10 emissions from agriculture, construction, vacant land and alluvial areas. For agriculture, the control factor applied was 0.699 (i.e., 1 - compliance rate of 59 percent times control efficiency of 51 percent). The compliance rate was derived from the Rule Effectiveness Study for Agricultural Best Management Practices documented in the 2005 PEI. The control efficiency was derived from Table 4-2 of the Technical Support Document for Quantification of Agricultural Best Management Practices, prepared for ADEQ by URS and ERG, June 2001 which assumes that one Best Management Practice is applied to crop land.

For construction, the control factor applied was 0.541 (i.e., 1 - compliance rate of 51 percent times control efficiency of 90 percent). The compliance rate was derived from the Rule 301 Effectiveness Study documented in the 2005 PEI. The control efficiency is consistent with the value used in the Revised MAG 1999 Serious Area PM-10 Plan.

For vacant land and alluvial areas, the control factor applied was 0.398 (i.e., 1 - compliance rate of 68 percent times control efficiency of 88.6 percent). The compliance rate was derived from the Rule 310.01 Effectiveness Study for vacant lots documented in the 2005 PEI. The control efficiency is consistent with the value used in the Revised MAG 1999 Serious Area PM-10 Plan.

Windblown construction emissions were split into residential, commercial, and road construction based on the 2005 PEI distribution of emissions in these categories. The surrogate used to create the growth factors for windblown construction emissions is the same as for non-windblown construction. The growth factors for windblown construction are derived by dividing the average permitted earthmoving acreage in 2004-2007 by the acreage in 2004, rather than 2005. (See construction permit data in the section on Construction earlier in this Chapter.)

The base case windblown dust emissions for all categories, except agriculture, are held constant after 2007. As discussed above, windblown agricultural emissions continue to decline each year due to the attrition of agricultural land caused by rapid urbanization of the PM-10 nonattainment area. The windblown PM-10 emissions and the growth factors for 2007-2010 are summarized below.

Windblown PM-10 Emissions

	Base Year	Emissions (tons/yr)	Growth Factors (Relative to Base Year) 2007	2008	2009	2010
Residential Construction	2004	1,311.5	1.08	1.08	1.08	1.08
Commercial Construction	2004	213.1	1.28	1.28	1.28	1.28
Road Construction	2004	13.1	1.43	1.43	1.43	1.43
Agriculture	2003	1,128.0	0.92	0.88	0.84	0.80
Vacant Land	2004	5,580.0	1.00	1.00	1.00	1.00
Other	2005	495.0	1.00	1.00	1.00	1.00

NONROAD MOBILE SOURCES

Nonroad mobile sources are those that move or are movable within a 12-month period and are not licensed or certified as highway vehicles. This category includes exhaust emissions from equipment used in agriculture, construction, mining, landscaping, commerce, industry, and recreation. The category also includes aircraft, airport equipment, and locomotives. The growth factors vary by equipment type.

The 2005 PEI estimate of PM-10 emissions from all nonroad mobile sources is 2,012 tons for the PM-10 nonattainment area. The major source categories are discussed in the sections that follow.

Aircraft and Airport Ground Support Equipment

The 2005 PEI estimate of PM-10 emissions from aircraft of 158 tons and airport ground support equipment of 17 tons were grown to 2007-2010 based on the population projections for Maricopa County shown in Table II-1.

Locomotive Emissions

The 2005 PEI estimate of PM-10 emissions from locomotives of 38 tons was held constant in 2007-2010. The Union Pacific and Burlington Northern Santa Fe Railroads provided locomotive fuel usage for Maricopa County of 11,183,519 gallons in 2002 and 9,604,157 gallons in 2005. Since these data represent the entire County, show a decline in usage and provide only two points from which to extrapolate, the locomotive emissions for the PM-10 nonattainment area are held constant at the PEI estimate of 38 tons for 2005.

Other Nonroad Mobile Source Equipment

For nonroad sources other than aircraft, airport ground support equipment, and locomotives, MAG ran the EPA NONROAD model for 2005 and 2007-2010 to estimate the nonroad PM-10 emissions. To maintain consistency with the 2005 PEI nonroad emissions estimates, MAG used the same input assumptions as MCAQD in running the NONROAD model for 2005. Equipment population and activity levels for commercial lawn and garden equipment were based on a 2003 survey in Maricopa County conducted by ENVIRON. For other equipment types, the EPA NONROAD model default assumptions for equipment population and activity levels in Maricopa County were used. The NONROAD model projects that the equipment populations in Maricopa County will increase at a rate of about two percent per year. At the same time, the PM-10 emission rates in the NONROAD model are declining for most equipment types, due to the phase-in of new equipment that meets more stringent EPA emissions standards. The declining emission rates more than offset the increases in equipment populations, resulting in a net decline in nonroad emissions for most equipment types over time. The NONROAD model output was used to develop growth factors for 2007-2010 relative to 2005, as shown in the tables below. The growth factors were applied to the 2005 PEI estimates by equipment type to project nonroad emissions in 2007-2010.

(tons/yr)

Nonroad Equipment Type	2005	2007	2008	2009	2010
Agricultural Equipment	37.70	34.89	33.54	32.22	30.90
Commercial Equipment	118.72	117.07	115.27	113.54	111.99
Construction and Mining Equipment	1356.18	1283.99	1260.01	1239.56	1221.94
Industrial Equipment	111.16	102.84	100.42	99.01	97.92
Lawn and Garden Equipment (Com)	120.92	120.85	121.35	122.32	123.77
Lawn and Garden Equipment (Res)	54.31	52.73	52.33	52.30	52.55
Lawn and Garden Equipment Total	175.23	173.58	173.68	174.62	176.32
Pleasure Craft	11.37	10.10	9.49	8.90	8.35
Railroad Equipment	1.16	1.13	1.11	1.09	1.07
Recreational Equipment	42.27	45.33	45.30	44.93	44.30
Total Nonroad Emissions	1853.79	1768.93	1738.82	1713.87	1692.79

	2007	2008	2009	2010
Nonroad Equipment Type	Growth factors (relative to 2005)			
Agricultural Equipment	0.93	0.89	0.85	0.82
Commercial Equipment	0.99	0.97	0.96	0.94
Construction and Mining Equipment	0.95	0.93	0.91	0.90
Industrial Equipment	0.93	0.90	0.89	0.88

Lawn and Garden Equipment Total	0.99	0.99	1.00	1.01
Pleasure Craft	0.89	0.83	0.78	0.73
Railroad Equipment	0.97	0.96	0.94	0.92
Recreational Equipment	1.07	1.07	1.06	1.05

ONROAD MOBILE SOURCES

The PM-10 emissions from onroad mobile sources include emissions from exhaust, tire wear and brake wear; reentrained dust from paved roads; and travel on unpaved roads. Each of these three categories is discussed separately below.

Exhaust, Tire Wear, and Brake Wear Emissions

The 2005 PEI estimates of PM-10 emissions from onroad mobile sources are 1,041 tons for exhaust, 305 tons for tire wear, and 394 tons for brake wear. MAG ran the EPA MOBILE6.2 model to obtain 2005 and 2007-2010 PM-10 emissions rates for exhaust, tire wear, and brake wear from onroad mobile sources. The MAG EMME/2 travel demand models were applied to simulate vehicle miles of travel (VMT) for 2005 and 2007-2010. MAG applied GIS to extract the VMT in the PM-10 nonattainment area from the 2005, 2007, 2008, 2009 and 2010 traffic assignments. The VMTs were multiplied by the MOBILE6.2 emissions rates to develop the PM-10 emissions shown in the table below. The detailed calculations are shown in Appendix II, Exhibit 1. The growth factors in the total column were applied to the 2005 PEI estimate of 1,740 tons to project total annual exhaust, tire wear, and brake wear PM-10 emissions in 2007-2010.

	PM-10 Emissions (metric tons/day)						Growth factors (relative to 2005)			
	2005	2007	2008	2009	2010		2007	2008	2009	2010
Exhaust	2.587	2.419	2.234	1.977	1.796		0.94	0.86	0.76	0.69
Tire wear	0.759	0.810	0.835	0.860	0.885		1.07	1.10	1.13	1.17
Brake wear	0.979	1.045	1.076	1.108	1.140		1.07	1.10	1.13	1.16
Total	4.325	4.274	4.145	3.945	3.822		0.99	0.96	0.91	0.88

Reentrained Dust from Paved Roads

The 2005 PEI estimate of PM-10 emissions from dust reentrained into the air by vehicles traveling on paved roads is 13,783 tons. The paved road emissions in 2007 were estimated by MAG based on AP-42 emission rates, the latest vehicle miles of travel (VMT) estimates, and updated assumptions for reductions due to PM-10 certified street sweepers. The VMT estimates were derived from the MAG EMME/2 travel demand models based on the latest population and employment projections approved by the MAG Regional Council in May

2007. The VMT for the PM-10 nonattainment area was extracted from the traffic assignments output by the EMME/2 models using geographic information systems (GIS). The paved road PM-10 emissions rates are based on equations in EPA, AP-42, Section 13.2.1.3, November 2006. The independent variables in the AP-42 equations are the average weight of the vehicles traveling on the road, the road surface silt loading, and the number of days with at least 0.01 inch of precipitation. The assumptions used to develop PM-10 emissions rates for paved roads are consistent with the 2005 Periodic Emissions Inventory, except that the mean vehicle weight has been increased from 3 tons to 3.18 tons, based on the default value provided by the EPA Emissions Inventory Improvement Program at http://www.epa.gov/ttn/chief/eiip/techreport/volume09/pavrd3.pdf. There were 36 days in the PM-10 nonattainment area on which precipitation of 0.01 inch or more was measured in 2005. The silt loading values were derived from the Revised MAG 1999 Serious Area PM-10 Plan for three facility types: 0.23 g/m2 for low volume arterials (<10,000 average weekday traffic), 0.067 g/m2 for other arterials, and 0.02 g/m2 for freeways.

Based on these input assumptions, the PM-10 emissions rates obtained from the AP-42 equations were 1.70 g/mi for low volume arterials, 0.65 g/mi for all other arterials, and 0.18 g/mi for freeways. Applying these rates to the VMT by facility type in the PM-10 nonattainment area produces the uncontrolled paved road emissions in the tables shown below.

2007-2010 VMT and Uncontrolled Paved Road PM-10 Emissions in the PM-10 Nonattainment Area

Facility Type	2007 VMT (on an annual average day)	2007 Uncontrolled PM-10 Emissions (tons/year)
Low volume arterials	14,069,620	9,623.3
Other arterials	40,792,971	10,668.2
Freeways	31,812,177	2,303.9
Total	86,674,768	22,595.4

Facility Type	2008 VMT (on an annual average day)	2008 Uncontrolled PM-10 Emissions (tons/year)
Low volume arterials	14,261,506	9,754.5
Other arterials	42,225167	11,042.8
Freeways	32,808,599	2,376.0
Total	89,295,272	23,173.3

Facility Type	2009 VMT (on an annual average day)	2009 Uncontrolled PM-10 Emissions (tons/year)
Low volume arterials	14,453,142	9,885.6
Other arterials	43,647,035	11,414.6
Freeways	34,172,504	2,474.8
Total	92,272,681	23,775.0

Facility Type	2010 VMT(on an annual average day)	2010 Uncontrolled PM-10 Emissions (tons/year)
Low volume arterials	14,654,378	10,023.3
Other arterials	45,381,806	11,868.3
Freeways	35,164,266	2,546.6
Total	95,200,450	24,438.2

The uncontrolled PM-10 emissions shown above do not include credit for PM-10 certified street sweepers that are being used throughout the PM-10 nonattainment area. During the six year period, FY 2001-2006, MAG member agencies purchased 103 PM-10 certified street sweepers to replace non-certified sweepers, increase the frequency of sweeping, and expand the area swept in the PM-10 nonattainment area. The agencies purchased the sweepers with MAG Congestion Mitigation and Air Quality Improvement (CMAQ) funds and provided a minimum local match of 5.7 percent of the cost of each sweeper. As part of the funding request, the agencies provided MAG with data on the lane miles to be swept, the traffic volume per lane swept, and the sweeping cycle length. These data have been used to quantify the PM-10 emissions reductions attributable to the 103 PM-10 certified sweepers purchased in FY 2001-2006.

The general approach used to quantify the benefit of the 103 PM-10 certified sweepers is documented in MAG, Methodologies for Evaluating Congestion Mitigation and Air Quality Improvement Projects, August 15, 2005 (see Appendix II, Exhibit 2). The changes that have been made to the CMAQ methodology for quantifying the emission reduction benefits of PM-10 certified street sweepers are described below.

The average arterial emissions factor of 1.1 grams per mile used in the CMAQ methodology for PM-10 certified street sweepers has been reduced to 0.92 grams per mile. The new emissions factor represents a weighted average of the AP-42 PM-10 emission rates of 1.70 grams per mile for low volume arterials and 0.65 grams per mile for other arterials. The assumptions used to develop the paved road PM-10 emission rates are discussed above. These AP-42 emission factors were weighted by the 2007 vehicle miles of travel on low and high volume arterials in the PM-10 nonattainment area to produce an average arterial emissions factor of 0.92 grams per mile.

New return-to-equilibrium periods and sweeper efficiencies for PM-10 certified and non-certified sweepers were provided to MAG by Sierra Research on July 24, 2007. The new data is based on a June 1999 report by the College of Engineering, Center for Environmental Research and Technology, University of California, Riverside, entitled, "PM-10 Efficiency Street Sweeper Evaluations."

Based on the data provided by Sierra Research, the return-to-equilibrium silt loadings for roads swept with PM-10 certified units were increased from 8 to 10 days; and for non-certified sweepers, from 3 to 7 days. The sweeping efficiency one day after sweeping with a PM-10 certified unit was increased from 80 percent to 86 percent, while the comparable efficiency for non-certified sweepers was increased from 30 percent to 55 percent. The resultant emissions factors for PM-10 certified and non-certified sweepers are shown below.

PM-10 Certified Sweeper Emissions Factors (g/mi) = 86% Efficiency		Average for Arterials	Average for Freeways
	1st day after sweeping	0.26	0.05
	2nd day after sweeping	0.36	0.07
	3rd day after sweeping	0.46	0.09
	4th day after sweeping	0.54	0.11
	5th day after sweeping	0.62	0.12
	6th day after sweeping	0.69	0.13
	7th day after sweeping	0.76	0.15
	8th day after sweeping	0.82	0.16
	9th day after sweeping	0.88	0.17
	10th day after sweeping	0.92	0.18

Non-Certified Sweeper Emissions Factors (g/mi) = 55% Efficiency		Average for Arterials	Average for Freeways
	1st day after sweeping	0.55	0.11
	2nd day after sweeping	0.62	0.12
	3rd day after sweeping	0.69	0.14
	4th day after sweeping	0.76	0.15
	5th day after sweeping	0.83	0.16
	6th day after sweeping	0.89	0.17
	7th day after sweeping	0.92	0.18

The emissions factors above were applied to the data on lane miles swept, ADT per lane, and sweeping frequency for each sweeper purchased in FY 2001-2006. In converting from a daily to an annual benefit, the PM-10 emissions reductions for the 103 sweepers purchased in FY 2001-2006 have been reduced to account for equipment maintenance and holidays. The older the sweeper, the less it is assumed to be used. For example, in calculating the credit for 2007, the utilization of the sweepers is assumed to be 95 percent for the newest units (i.e., purchased in FY 2006), 90 percent for units purchased in FY 2005, 85 percent for units purchased in FY 2004, and 75 percent for units purchased in FY 2001-2003. In succeeding years, the usage of the sweepers decreases by five percent per year. The detailed input assumptions for the 103 sweepers are shown in Appendix II, Exhibit 4. The emissions reduction credit for the PM-10 certified sweepers purchased in FY 2001-2006, after application of the usage factors, is summarized below.

Sweepers Purchased in	# of sweepers	PM-10 Emissions Reductions with Usage Factors Applied (tons/year)			
		2007	2008	2009	2010
FY 2001-2003	52	1,542.3	1,439.5	1,336.7	1,233.8
FY 2004	16	416.5	392.0	367.5	343.0
FY 2005	24	1,860.1	1,756.7	1,653.4	1,550.1
FY 2006	11	2,022.4	1,916.0	1,809.5	1,703.1
Total	103	5,841.3	5,504.2	5,167.1	4,830.0

The paved road PM-10 emissions reductions due to deployment of the 103 PM-10 certified street sweepers are subtracted from the uncontrolled paved road emissions shown earlier in this section to obtain the 2007-2010 base case paved road emissions of 16,754 tons in 2007, 17,669 tons in 2008, 18,608 tons in 2009, and 19,608 tons in 2010.

Travel on Unpaved Roads

The 2005 PEI estimate of PM-10 emissions from vehicles traveling on unpaved roads is 8,490 tons. The PEI estimate is based on an inventory of unpaved roads developed for the Revised MAG 1999 Serious Area PM-10 Plan. For the Five Percent Plan, MAG updated the mileage of unpaved roads, using GIS and aerial imagery for 2006. Based on this analysis, MAG estimated that there were 1,680 miles of unpaved roads in the PM-10 nonattainment area in 2006.

In addition, MAG used image recognition software, aerial photographs, and the Maricopa County Assessor's files to identify the number of dwelling units located on unpaved roads in 2006. Applying an average trip rate of 10 vehicle trips per residential unit per day[1] produces the distribution of unpaved road mileage by average weekday trips (ADT) shown below.

2006 VMT and PM-10 Emissions from Unpaved Roads in the PM-10 Nonattainment Area

Dwelling Units	Length in Miles	ADT	VMT	Uncontrolled Emissions (kg/day)	Controlled Emissions (kg/day)
0	705.50	1	706	470	470
1	93.23	10	932	621	621
2	77.33	20	1,547	1,031	1,031
3	74.01	30	2,220	1,480	1,480
4	51.67	40	2,067	1,378	1,378
5	43.82	50	2,191	1,461	1,461
6	38.82	60	2,329	1,553	1,553
7	46.32	70	3,242	2,161	2,161
8	43.58	80	3,486	2,324	2,324
9	44.55	90	4,010	2,673	2,673
10	36.76	100	3,676	2,450	2,450
11	32.27	110	3,550	2,366	2,366
12	29.73	120	3,568	2,378	2,378
13	30.72	130	3,994	2,662	2,662
14	32.56	140	4,558	3,039	3,039
15	27.91	150	4,187	2,791	1,395
16	22.14	160	3,542	2,361	1,181
17	21.49	170	3,653	2,435	1,218
18	23.95	180	4,311	2,874	1,437
19	19.94	190	3,789	2,526	1,263
20	184.00	200	36,800	24,532	12,266
Totals	1,680.30		98,357	65,567	46,808

[1]The Institute of Traffic Engineers (ITE) reports that residential units generate 9.55 average weekday trips (ADT). To simplify the ADT ranges, this rate has been rounded from 9.55 to10.

The VMTs in the table above are based on average weekday traffic. These were multiplied by the AP-42 unpaved road emissions rate of 666.62 grams per mile to produce the uncontrolled PM-10 emissions from unpaved roads for each weekday traffic volume group.

The equation used to calculate the PM-10 emissions rate for unpaved roads is contained in AP-42, Section 13.2.2, November 2006. The independent variables in the equation are surface material silt content, mean vehicle weight, surface moisture content and mean vehicle speed. The inputs to the AP-42 equation were a silt content of 11.9 percent, a soil moisture content of 0.5 percent, an average vehicle weight of 3 tons, and an average vehicle speed of 25 miles per hour. According to the traffic handbook published by the Motor Vehicle Division of the Arizona Department of Transportation, 25 mph is the default speed limit for roads that do not have a posted speed in Arizona. Applying the 666.62 grams per mile to the VMT estimates produces the uncontrolled PM-10 emissions above.

The uncontrolled unpaved road emissions for ADTs of 150 or more were multiplied by 50 percent to derive controlled emissions. This reduction reflects the Maricopa County Rule 310.01 requirement that unpaved roads with 150 ADT or more must be stabilized by June 10, 2004. It is assumed that these high volume dirt roads are being stabilized with dust suppressants that have a control efficiency of 50 percent.

The 46,808 kilograms per weekday is multiplied by 0.91 to convert to annual average daily emissions. The total controlled emissions for unpaved roads in the PM-10 nonattainment area are 42,595 kilograms per annual average day or 17,138 tons per year in 2006.

The 2006 PM-10 emissions are projected to 2007-2010 based on growth factors representing the expected annual rate of increase in VMT on unpaved roads. Based on an analysis of 2003 aerial imagery for the PM-10 nonattainment area, MAG estimated that there were 1,582 miles of unpaved roads in 2003, compared with 1,680 miles in 2006. This translates into an average annual increase in unpaved road mileage of 2.0 percent per year between 2003 and 2006. It is assumed that the new miles created between 2003 and 2006 are due primarily to lots splits, which are not required to obtain city or county permits and thereby avoid subdivision requirements to pave the roads. The maximum lot split allowed by state law is five. Assuming that the average number of dwelling units associated with each lot split is three, the average weekday traffic generated by lot splits (using the ITE trip rate of 10 trips per residential unit) would be 30 ADT.

The ADT for all unpaved roads in 2006 is 59 (derived by dividing the daily VMT of 98,357 in the table above by the total miles of 1,680.3). The projected annual rate of increase in VMT on unpaved roads in the PM-10 nonattainment area is calculated as the product of the increase in miles and the ratio of the lot split ADT to the 2006 ADT in the nonattainment area.

2.0% increase in mileage x 30 ADT/59 ADT = 1.02% annual increase in unpaved road VMT

Applying this annual rate of increase in VMT to the 2006 VMT produces the growth factors for 2007-2010 shown below. The growth factors are applied to the 2006 PM-10 emissions of 17,138 tons per year to project base case unpaved road emissions in 2007-2010.

Growth Factors for Unpaved Road Emissions
(Relative to 2006)

2007	2008	2009	2010
1.0102	1.0205	1.0309	1.0414

SUMMARY OF BASE CASE EMISSIONS

A summary of the 2005 and 2007-2010 base case emissions is shown in Table II-4. The 2007-2010 base case emissions were obtained by applying the growth surrogates and factors discussed above. The committed measures in the Five Percent Plan have not been applied to the base case emissions.

The 2007 base case emissions are 13,893 tons (i.e., 16.4 percent) higher than the 2005 PEI emissions for the PM-10 nonattainment area. Most of this increase is attributable to paved and unpaved road emissions. The changes in methods and assumptions discussed in the sections on Reentrained Dust from Paved Roads and Travel on Unpaved Roads resulted in a 21.6 percent increase in paved road emissions and a more than doubling of unpaved road emissions between 2005 and 2007.

Between 2007 and 2010, the base case emissions increase by 4.1 percent. The largest increases occur in paved road emissions which grow by 2,854 tons (17 percent), over the three year period, due to projected growth in vehicle miles of travel in the nonattainment area.

The source categories contributing the largest share of PM-10 emissions in 2005, as well as 2010, are construction with 38.8 percent in 2005 and 33.1 percent in 2010; paved roads with 16.3 percent in 2005 and 19.1 percent in 2010; and unpaved roads with 10 percent in 2005 and 17.4 percent in 2010. These three sources are responsible for 65 percent of the PM-10 emissions in 2005 and 70 percent of the base case PM-10 emissions in 2010.

The next chapter discusses the methods and assumptions used to quantify the committed control measures and demonstrate annual five percent reductions in PM-10 emissions between 2007 and 2010. Credit for these measures is applied to the base case emissions in Table II-4 to obtain the emissions with committed control measures, shown in Table III-2.

Table II-4. 2005 and 2007- 2010 Base Case PM-10 Emissions in the PM-10 Nonattainment Area (tons/year)

Source Categories	2005[1]	% of total	2007	% of total	2008	% of total	2009	% of total	2010	% of total
Stationary point sources	1,636	1.9%	1,792	1.8%	1,870	1.9%	1,948	1.9%	2,026	2.0%
Industrial processes	3,226	3.8%	3,533	3.6%	3,686	3.7%	3,840	3.8%	3,993	3.9%
Fuel combustion & fires	5,625	6.6%	5,665	5.7%	5,685	5.7%	5,705	5.6%	5,726	5.6%
Agriculture	2,758	3.3%	3,559	3.6%	3,416	3.4%	3,281	3.2%	3,152	3.1%
Construction (residential)	12,046	14.2%	11,783	11.9%	11,783	11.8%	11,783	11.6%	11,783	11.5%
Construction (commercial)	11,202	13.2%	12,030	12.2%	12,030	12.0%	12,030	11.9%	12,030	11.7%
Construction (road)	7,244	8.5%	6,659	6.8%	6,659	6.7%	6,659	6.6%	6,659	6.5%
Other land clearing	2,476	2.9%	3,467	3.5%	3,467	3.5%	3,467	3.4%	3,467	3.4%
Travel on unpaved parking lots	3,009	3.6%	3,184	3.2%	3,272	3.3%	3,359	3.3%	3,447	3.4%
Offroad rec vehicles	2,159	2.5%	2,285	2.3%	2,347	2.3%	2,410	2.4%	2,473	2.4%
Leaf blowers fugitive dust	843	1.0%	892	0.9%	917	0.9%	941	0.9%	966	0.9%
Windblown vacant	6,009	7.1%	5,580	5.7%	5,580	5.6%	5,580	5.5%	5,580	5.4%
Windblown other	495	0.6%	495	0.5%	495	0.5%	495	0.5%	495	0.5%
Nonroad equipment	2,012	2.4%	1,937	2.0%	1,913	1.9%	1,894	1.9%	1,879	1.8%
Exhaust/tire wear/brake wear	1,740	2.1%	1,719	1.7%	1,668	1.7%	1,587	1.6%	1,537	1.5%
Paved roads (including trackout)	13,783	16.3%	16,754	17.0%	17,669	17.7%	18,608	18.4%	19,608	19.1%
Unpaved roads	8,490	10.0%	17,312	17.5%	17,489	17.5%	17,667	17.4%	17,848	17.4%
Total PM-10 Emissions	**84,753**	100.0%	**98,646**	100.0%	**99,946**	100.0%	**101,255**	100.0%	**102,668**	100.0%

[1]Based on the MCAQD 2005 Periodic Emissions Inventory for PM-10, dated May, 2007

III. EVALUATION OF COMMITTED CONTROL MEASURES

This chapter describes the committed control measures in the MAG 2007 Five Percent Plan for PM-10 that were quantified to meet the five percent per year requirements of Section 189(d) of the Clean Air Act. The emissions reduction benefits of these measures were also used in modeling attainment and demonstrating reasonable further progress.
There are legally binding commitments in the Five Percent Plan to implement fifty-three measures. Twenty-five of these measures have been quantified as committed control measures. Nine additional measures have been quantified as contingency measures; these are discussed in the next chapter.

The benefits of some of the committed control measures are difficult to quantify. However, the implementation of these measures will reinforce the impact of the committed control measures and provide additional assurance that the five percent reductions and attainment of the PM-10 standard will be achieved.

EVALUATION OF INDIVIDUAL COMMITTED CONTROL MEASURES

Twenty-five committed control measures have been quantified to meet the annual five percent reduction requirement in the Clean Air Act. A discussion of the methodologies and assumptions used to quantify the individual committed control measures is provided below.

Measure #2 - Extensive Dust Control Training Program

Maricopa County has committed to hire 2 dust control compliance and 2 administrative support personnel by December 2007 to coordinate and conduct the extensive dust control training program. This program is expected to increase compliance with Maricopa County Rule 310 for construction sources by providing a larger number of construction workers and supervisors with training on the fugitive dust control rules and techniques to avoid and suppress dust. Since Maricopa County Measure 2 indicates that the extensive training will be phased-in during the first year of the program, this measure has a reduced benefit in 2008 (i.e., one percent increase in base compliance rate of 51 percent). The base compliance rate was obtained from a rule effectiveness study documented in MCAQD, 2005 Periodic Emission Inventory for PM-10 for the Maricopa County, Arizona, Nonattainment Area, May 2007 (Appendix B, Exhibit 1, of the Five Percent Plan). When the program is fully operational in 2009 and 2010, Rule 310 compliance is expected to increase from the compliance rate of 52 percent in 2008 to 54 percent in 2009 and 55 percent in 2010. The reductions in construction emissions by category are shown below.

Increase in Rule 310 compliance	1.0% in 2008 (from 51% to 52%)
	3.0% in 2009 (from 51% to 54%)
	4.0% in 2010 (from 51% to 55%)

	2007	2008	2009	2010
Rule 310 Compliance	51.0%	52.0%	54.0%	55.0%
Rule 310 Control Effectiveness	90.0%	90.0%	90.0%	90.0%
Rule 310 Effectiveness	45.9%	46.8%	48.6%	49.5%

PM-10 Emissions (tons/yr)	2007	2008	2009	2010
Residential Construction	10,363	10,363	10,363	10,363
Windblown Residential Construction	1,420	1,420	1,420	1,420
Commercial Construction	11,757	11,757	11,757	11,757
Windblown Commercial Construction	273	273	273	273
Road Construction	6,640	6,640	6,640	6,640
Windblown Road Construction	19	19	19	19
Other Land Clearing	3,467	3,467	3,467	3,467
Base Case Construction Emissions	33,939	33,939	33,939	33,939

	2007	2008	2009	2010
Uncontrolled Construction Emissions	62,734	62,734	62,734	62,734
Construction Emissions w/M2	33,939	33,374	32,245	31,681
Reduction due to M2 (tons/yr)	0	565	1,694	2,258
% reduction in 2007 emissions		0.6%	1.7%	2.3%

Measure #3 - Dust Managers At Construction Sites of 50 Acres and Greater and Measure #16 - Require Dust Coordinators at Earthmoving Sites of 5-50 Acres

Measures #3 and #16 will reduce PM-10 emissions by requiring on-site supervision of dust control operations at construction sites. Measure #16 will also reduce emissions at permitted sources of PM-10, such as non-metallic mineral processing facilities. Maricopa County committed to implement these measures as part of Maricopa County Measure 3. It is anticipated that Measures #3 and #16 will improve compliance with the Maricopa County fugitive dust control rules incrementally over the next three years, as the dust control coordinators (Rule 310) and fugitive dust control technicians (Rule 316) receive extensive training under Measure #2, become familiar with the strengthened rules (e.g., Measures #6 and #36-38), and apply more effective techniques to avoid or reduce PM-10 emissions.

Due to implementation of Measures #3 and #16, compliance with Rule 310 is expected to increase by three percent in 2008, five percent in 2009, and seven percent in 2010. These increases in compliance are applied after the increases for Measure #2. The benefit in 2008 is reduced by 25 percent to account for the March 2008 implementation date for rule revisions in the Maricopa County commitment. The reductions due to increased compliance with Rule 310 are shown below.

Increase in Rule 310 compliance	3.0% in 2008 (from 52% to 55%)
	5.0% in 2009 (from 54% to 59%)
	7.0% in 2010 (from 55% to 62%)

	With M2 2008	With M3 & M16 2008	With M2 2009	With M3 & M16 2009	With M2 2010	With M3 & M16 2010
Rule 310 Compliance	52.0%	55.0%	54.0%	59.0%	55.0%	62.0%
Rule 310 Control Effectiveness	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
Rule 310 Effectiveness	46.8%	49.5%	48.6%	53.1%	49.5%	55.8%

Construction Emissions	2008		2009		2010
Construction Emissions w/M2	33,374		32,245		31,681
Uncontrolled Construction Emissions	62,734		62,734		62,734
Construction Emissions w/M3&M16	32,104		29,422		27,728
Reduction due to M3 & M16 (tons/yr)	1,270		2,823		3,952

Construction Emissions by Source Category (tons/yr)	With M2 2008	Reduction w/M3/16	With M2 2009	Reduction w/M3/16	With M2 2010	Reduction w/M3/16
Residential Construction	10,190	388	9,845	862	9,673	1,207
Windblown Residential Construction	1,397	53	1,349	118	1,326	165
Commercial Construction	11,561	440	11,170	978	10,975	1,369
Windblown Commercial Construction	268	10	259	23	255	32
Road Construction	6,529	249	6,308	552	6,198	773
Windblown Road Construction	19	1	18	2	18	2
Other Land Clearing	3,410	130	3,294	288	3,237	404
Total Construction Emissions	33,374	1,270	32,245	2,823	31,681	3,952

Due to the requirement for fugitive dust control technicians on permitted sites of 5 acres or more, Measure #16 is also expected to improve compliance with Maricopa County Rule 316 for non-metallic mineral processing. The base compliance rate of 54 percent for Rule 316 is expected to increase by three percent in 2008, six percent in 2009, and nine percent in 2010. A rule effectiveness study in the 2005 Periodic Emissions Inventory for PM-10 (Appendix B, Exhibit 1) determined the base compliance rate for Rule 316. The 2005 base case emissions estimate for non-metallic mineral processing activities of 802 tons per year is based on data extracted from the 2005 PEI by MCAQD. The breakout of PM-10 emissions by type of activity is shown below.

Nonmetallic mineral processing activities	2005 PM-10 emissions (tons/yr)
Point sources	215.05
Area sources	430.89
ADEQ-permitted portables	101.70
Mining and quarrying	54.77
Total	802.41

The 2005 emissions were projected to 2008-2010 based on the growth in industrial employment for Maricopa County (see Table II-2). The emissions reductions due to increased compliance with Rule 316 are provided below. The benefit in 2008 is reduced by 25 percent to account for the March 2008 implementation date for rule revisions in the Maricopa County commitment.

The benefits of measures (i.e., Measure 8, 16 and 9/10/44) that reduce emissions from Rule 316 sources are apportioned to source categories based on the share of 2005 emissions in the table above. That is, 26.8 percent of the emissions reduction is applied to stationary point sources and 73.2 percent to industrial processes.

Increase in Rule 316 compliance	3.0% in 2008 (from 54% to 57%) 6.0% in 2009 (from 54% to 60%) 9.0% in 2010 (from 54% to 63%)			
	Base Case	with M16 2008	with M16 2009	with M16 2010
Rule 316 Compliance	54.0%	57.0%	60.0%	63.0%
Rule 316 Control Effectiveness	90.0%	90.0%	90.0%	90.0%
Rule 316 Effectiveness	48.6%	51.3%	54.0%	56.7%

	2008	2009	2010
Base case Rule 316 emissions (tons/yr)	917	955	993
Uncontrolled emissions	1,784	1,858	1,933
Emissions w/M16	881	855	837
Reduction due to M16	36	100	157
Total reductions in Rule 310 and Rule 316 emissions due to Measures #3 & #16 (tons/yr)	1,306	2,923	4,109
% reduction in total 2007 PM-10 emissions	1.3%	3.0%	4.2%

Measure #8 - Conduct Nighttime and Weekend Inspections

Maricopa County Measure 7 commits to implement proactive and complaint inspections of nonpermitted and permitted sources during non-daylight hours and on weekends through a combination of an on-call system and shift work. The County intends to begin conducting random and after hours inspections in January through June 2008 with after hours, weekend and on-call inspections beginning in June - September 2008. This measure is expected to increase compliance with Rules 310 and 316 by four percent in 2008, six percent in 2009, and eight percent in 2010. The Rule 310 compliance increases are applied after compliance increases for all other Rule 310 measures (i.e., Measures #2, 3/16, 9/10/44, and 36-38). The Rule 316 compliance increases are applied after compliance increases for all other measures that impact Rule 316 (i.e., Measures #16 and 9/10/44).

This measure is also expected to increase compliance with Rule 310.01 for vacant lots by one percent and decrease emissions from unpaved parking lots by two percent in 2008-2010. The benefits in 2008 are reduced by 25 percent to account for the implementation of the random and after hours inspections in January 2008, followed by the implementation of the after hours, weekend and on-call inspections in June 2008.

Increase in Rule 310 compliance	4% in 2008 (from 60% to 64%)
	6% in 2009 (from 67% to 73%)
	8% in 2010 (from 72% to 80%)

	With all other Rule 310 measures 2008	w/M8	With all other Rule 310 measures 2009	w/M8	With all other rule 310 measures 2010	w/M8
Rule 310 Compliance	60.0%	64.0%	67.0%	73.0%	72.0%	80.0%
Rule 310 Control Effectiveness	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
Rule 310 Effectiveness	54.0%	57.6%	60.3%	65.7%	64.8%	72.0%

Construction Emissions	2008		2009		2010
After M2, M3/16, M9/10/44, M36-38	28,858		24,905		22,082
Uncontrolled Construction Emissions	62,734		62,734		62,734
Construction Emissions w/M8	27,164		21,518		17,565
Reductions due to M8 (tons/yr)	1,694		3,388		4,517

Increase in Rule 316 compliance	4.0%	in 2008 (from 60% to 64%)
	6.0%	in 2009 (from 66% to 72%)
	8.0%	in 2010 (from 72% to 80%)

	With M3/16; M9/10/44 2008	With M8 2008	With M3/16; M9/10/44 2009	With M8 2009	With M3/16; M9/10/44 2010	With M8 2010
Rule 316 Compliance	60.0%	64.0%	66.0%	72.0%	72.0%	80.0%
Rule 316 Control Effectiveness	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
Rule 316 Effectiveness	54.0%	57.6%	59.4%	64.8%	64.8%	72.0%

	2008	2009	2010
Emissions with M3/16 & M9/10/44 (tons/yr)	821	754	680
Uncontrolled emissions	1,784	1,858	1,933
Emissions w/M8	773	654	541
Reduction in Rule 316 emissions due to M8	48	100	139

Increase in Rule 310.01 compliance for vacant lots after Measures 30 and 33 — 1.0% in 2008-2010 (from 75% to 76%)

	2008-2010 w/M30 & 33	2008-2010 w/M8
Rule 310.01 Compliance (vacant lots)	75.0%	76.0%
Rule 310.01 Control Effectiveness	88.6%	88.6%
Rule 310.01 Effectiveness	66.5%	67.3%

	2008	2009	2010
Emissions after Measures #30 & #33 (tons/yr)	5,247	4,710	4,710
Uncontrolled vacant lot emissions	14,040	14,040	14,040
Vacant Lot Emissions w/M8	5,153	4,586	4,586
Reduction in vacant lot emissions due to M8	93	124	124

Decrease in unpaved parking lot emissions after Maricopa County Measure 17 in M25	2.0% in 2008-2010		
	2008	2009	2010
Emissions w/Maricopa County Measure 17 in M25 (tons/yr)	3,255	3,292	3,378
Parking lot emissions w/M8	3,206	3,226	3,310
Reduction due to M8	49	66	68
Total reduction in Rule 310, Rule 316, vacant lot and unpaved parking lot emissions due to M8 (tons/yr)	1,884	3,678	4,848
% reduction in total 2007 PM-10 emissions	1.9%	3.8%	5.0%

Measure #9 - Increase Consistent Inspection Frequency for Permitted Facilities; Measure #10 - Increase Number of Proactive Consistent Inspections in Areas of Highest PM-10 Emissions Densities; and Measure #44 - Maricopa County Should Increase Enforcement in the Areas Where PM-10 Violations Continue to Occur, Along With Efforts Throughout the Region

The commitment to implement Measures #9, #10, and #44 is contained in Maricopa County Measure 8. In this chapter, these measures are referred to collectively as: Increase the Number of Proactive Rule 310 and Rule 316 Inspections. To implement these measures, the County has committed to hire 47 additional dust control compliance personnel to inspect construction sites and 5 additional compliance inspectors to inspect other permitted facilities. These new staff are scheduled to be hired and begin proactive inspections by June 2008.

It is anticipated that the additional compliance personnel will aggressively enforce Rule 310 and Rule 316. This is expected to increase compliance with Rule 310 by four percent in 2008, six percent in 2009, and eight percent in 2010. The increased enforcement is also expected to increase compliance with Rule 316 by three percent in 2008, six percent in 2009 and nine percent in 2010. The compliance increases are applied after the increases for Measures #2, #3 and #16. The calculations are shown separately for Rules 310 and 316 below. The benefits for Rule 310 and Rule 316 are reduced by 50 percent in 2008 to account for the implementation date of June 2008.

Increase in Rule 310 compliance — 4% in 2008 (from 55% to 59%)
6% in 2009 (from 59% to 65%)
8% in 2010 (from 62% to 70%)

	w/M2, M3/16 2008	w/M9/10/44	w/M2, M3/16 2009	w/M9/10/44	w/M2, M3/16 2010	w/M9/10/44
Rule 310 Compliance	55.0%	59.0%	59.0%	65.0%	62.0%	70.0%
Rule 310 Control Effectiveness	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
Rule 310 Effectiveness	49.5%	53.1%	53.1%	58.5%	55.8%	63.0%

Construction Emissions	2008	(tons/yr) 2009	2010
after implementation of M2 & M3/16	32,104	29,422	27,728
Uncontrolled Emissions	62,734	62,734	62,734
Construction Emissions w/M9/10/44	30,975	26,035	23,212
Rule 310 reduction due to M9/10/44	1,129	3,388	4,517

By Construction Category	w/M2 & M3/16 2008	M9/10/44 Reduction	w/M2 & M3/16 2009	M9/10/44 Reduction	w/M2 & M3/16 2010	M9/10/44 Reduction
Residential Construction	9,802	345	8,984	1034	8,466	1379
Windblown Residential Construction	1,344	47	1,231	142	1,160	189
Commercial Construction	11,121	391	10,192	1174	9,606	1565
Windblown Commercial Construction	258	9	236	27	223	36
Road Construction	6,281	221	5,756	663	5,425	884
Windblown Road Construction	18	1	17	2	16	3
Other Land Clearing	3,280	115	3,006	346	2,833	461
Total	32,104	1,129	29,422	3,388	27,728	4,517

Increase in Rule 316 compliance

3.0% in 2008 (from 57% to 60%)
6.0% in 2009 (from 60% to 66%)
9.0% in 2010 (from 63% to 72%)

	With M16 2008	With M9/10/44 2008	With M16 2009	With M9/10/44 2009	With M16 2010	With M9/10/44 2010
Rule 316 Compliance	57.0%	60.0%	60.0%	66.0%	63.0%	72.0%
Rule 316 Control Effectiveness	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
Rule 316 Effectiveness	51.3%	54.0%	54.0%	59.4%	56.7%	64.8%

	2008	2009	2010
Emissions with M16 (tons/yr)	869	855	837
Uncontrolled emissions	1,784	1,858	1,933
Emissions w/M9/10/44	821	754	680
Rule 316 reduction due to M9/10/44	24	100	157
Total Rule 310 and 316 reductions due to M9/10/44	1,153	3,488	4,673
% reduction in total 2007 PM-10 emissions	1.2%	3.6%	4.8%

Measure #21 - Ban Leaf Blowers from Blowing Debris into Streets

SB 1552 requires that cities, towns and counties in Area A develop and enforce ordinances to ban blowing of landscape debris into public streets at any time by any person. The ordinances are to be adopted and enforced by March 31, 2008. Assuming that 10 percent of the emissions from leaf blowers are blown into the streets and compliance with the ban will be 20 percent, this measure will effect the following reductions in PM-10 emissions. The emissions reduction benefit of this measure in 2008 has been decreased by 25 percent to reflect the implementation date of March 31, 2008.

	(tons/yr) 2008	2009	2010
Base case leaf blower emissions	917	941	966
Reduction due to measure #21	13.7	18.8	19.3
% reduction in total 2007 PM-10 emissions	0.01%	0.02%	0.02%

Measure #22 - Implement a Leaf Blower Outreach Program

SB 1552 requires educational materials to be prepared by the Arizona Department of Environmental Quality (ADEQ) and provided to buyers or renters of leaf blowing equipment by September 19, 2007. In addition, SB 1552 requires persons operating leaf blowers for remuneration to attend ADEQ approved training once every 3 years. The implementation date for the training is December 31, 2008. It is assumed that these requirements together will reduce annual leaf blower emissions by 0.1 percent. Credit for this measure is taken after leaf blower emissions were reduced by Measures #21 and #45. Since the training component of this measure will produce the major benefit, no emissions reduction credit is taken until 2009.

	(tons/yr) 2008	2009	2010
Leaf blower emissions with measures #21 & #45	835	830	852
Reductions due to measure #22	0.0	0.8	0.9
% reduction in total 2007 PM-10 emissions	0.000%	0.001%	0.001%

Measure #23 - Ban ATV Use on High Pollution Days

SB 1552 prohibits operation of off-road vehicles on unpaved surfaces during high pollution advisory (HPA) days forecasted by ADEQ for particulate matter. This ban applies to Area A and is to be implemented by ADEQ by September 19, 2007. Based on historical data, it is assumed that there will be 20 HPA days for particulate matter each year and a 20 percent compliance rate on these days. Credit for Measure #23 is applied to the base case off-road recreational vehicle (ORV) emissions as shown below.

Average # of HPA days/year = 20

	2008	2009	2010
Base case ORV emissions	2,347	2,410	2,473
ORV emissions on HPA days (x 20/365)	128.6	132.1	135.5
Reductions due to measure #23 (assuming 20% compliance on HPA days)	25.7	26.4	27.1
% reductions in total 2007 PM-10 emissions	0.03%	0.03%	0.03%

Measure #25 - Pave or Stabilize Existing Unpaved Parking Lots

There are three components to Measure #25. Maricopa County Measure 17 is described in subsection (1); provisions of SB 1552 are described in subsection (2) below; and commitments by two jurisdictions are described in subsection (3).

(1) For the Five Percent Plan, Maricopa County submitted a commitment (Maricopa County Measure 17) to conduct proactive and complaint-based inspections of existing parking lots located within unincorporated areas of Maricopa County and commence enforcement as necessary to require dustproof paving methods. The County has committed to hire 4 inspectors by June 2008 to conduct inspections of unpaved parking lots. Proactive inspections of existing high volume use unpaved parking areas in unincorporated areas are scheduled to begin by October 1, 2008. This commitment is expected to decrease unpaved parking lot emissions by two percent in 2008-2010. The benefit of this Maricopa County commitment in 2008 is reduced by 75 percent to account for the implementation date for proactive inspections of October 1, 2008. The calculations are shown below:

	(tons/yr)		
	2008	2009	2010
Base case unpaved parking lot emissions	3,272	3,359	3,447
Controlled emissions with Maricopa County Measure 17	3,255	3,292	3,378
Reduction due to (1)	16.4	67.2	68.9

(2) SB 1552 has two requirements to pave or stabilize unpaved parking lots. In the discussion below, these are referred to as SB 1552-P1 and SB 1552-P2.

SB 1552-P1: For other then residential building with less than five units, SB 1552 requires that cities and towns in Area A adopt or amend codes/ordinances to require dustproof paving of parking, maneuvering and ingress/egress areas, excluding residential buildings with five or more units. The new or revised codes/ordinances are required by March 31, 2008 and enforcement must begin by October 1, 2008.

SB 1552-P2: For residential buildings with less than five units that have parking, maneuvering and ingress/egress areas of 3,000 square feet or more, SB 1552 requires that cities and towns in Area A and counties in the PM-10 nonattainment area adopt or amend codes/ordinances to require paving or stabilization. The new or revised codes/ordinances are required by March 31, 2008 and enforcement must begin by October 1, 2009.

Implementation of SB 1552-P1 is expected to reduce PM-10 emissions from unpaved parking areas by 5 percent per year in the PM-10 nonattainment area. Because the new requirements do not have to be enforced until October 1, 2008, only 25 percent of the reduction is taken in 2008.

Implementation of SB 1552-P2 is expected to reduce PM-10 emissions from unpaved parking areas by an additional 5 percent per year in the PM-10 nonattainment area. The 5 percent reduction is calculated after credit is taken for SB 1552-P1. To account for the enforcement date of October 1, 2009, no credit for SB 1552-P2 is taken in 2008 and only 25 percent of the credit is taken in 2009.

		(tons/yr)	
	2008	2009	2010
Unpaved parking lot emissions after (1) and M8	3,206	3,226	3,310
5% reduction due to SB1552-P1	40.1	161.3	165.5
Additional 5% reduction due to SB1552-P2		38.3	157.2
Total reductions due to (2)	40.1	199.6	322.7

(3) Two municipalities submitted commitments that have been quantified for Measure #25. The Town of Paradise Valley committed to require dustproofing of five commercial dirt parking lots within two years. The City of Chandler committed to pave or stabilize 100 acres of City parking lots in FY 2008-2010. To be conservative, it was assumed that the Paradise Valley and Chandler parking lots would be stabilized, rather than paved. The stabilization of parking lots in both jurisdictions was assumed to begin by January 1, 2009. Paradise Valley provided MAG with the number of acres of parking lots to be stabilized. The emissions factor and average vehicle miles of travel for unpaved parking lots were obtained from the MCAQD 2005 Periodic Emissions Inventory for PM-10. The PM-10 emissions reductions attributable to stabilizing the dirt parking lots in Paradise Valley and Chandler are shown below:

Reductions due to Paradise Valley and Chandler commitments to stabilize parking lots

Acres to be dustproofed - Paradise Valley	9.53	
Acres to be stabilized or paved - Chandler	100	
PM-10 emissions factor for unpaved parking lots	609.23	g/VMT
Vehicle miles of travel (VMT) on unpaved parking lots	2	VMT/acre/day
Control Effectiveness of Dustproofing	50%	

		(tons/yr)	
	2008	2009	2010
Reductions due to Paradise Valley commitment		2.3	2.3
Reductions due to Chandler commitment		24.5	24.5
Total reductions due to (3)		26.8	26.8

Total reductions due to measure #25: (1)+(2)+(3)	56.4	293.6	418.5
% reduction in total 2007 PM-10 emissions	0.1%	0.3%	0.4%

Measure #28 - Pave or stabilize unpaved shoulders

Maricopa County and twelve cities and towns committed to stabilize and pave unpaved shoulders in the PM-10 nonattainment area. The miles of unpaved shoulders to be paved or stabilized are summarized by jurisdiction, year, and the type of shoulder treatment in the table below. The miles of unpaved shoulders shown in the table are linear (i.e., one mile represents one mile of shoulder on one side of the adjacent road). If a jurisdiction made a commitment in terms of centerline miles, the centerline miles were doubled to represent linear miles. The miles in the table are accumulated in successive years; e.g., Phoenix committed to pave 9 miles of shoulders in 2007 and an additional 9.5 miles in 2008, for a total of 18.5 miles paved in 2008.

	Linear Miles of Unpaved Shoulders to be Treated				
Jurisdiction	2007	2008	2009	2010	Type of Treatment
Maricopa County	10.2	27.2	38.2	49.2	Paved
Apache Junction		4	4	4	Stabilized
Cave Creek	7	7	7	7	Stabilized
Chandler		12	24	35	Stabilized
Chandler		5	10	14.7	Paved
El Mirage	15	15	15	15	Stabilized
Glendale		4	4	4	Stabilized
Gilbert	38	38	38	38	Stabilized
Goodyear			12.25	12.25	Paved
Mesa	47	47	47	47	Stabilized
Phoenix	9	18.5	26.5	33.5	Paved
Queen Creek		10	21	43.5	Stabilized
Scottsdale	85	85			Stabilized
Surprise			4	4	Stabilized
Total Paved	19.2	50.7	87.0	109.7	Total Paved
Total Stabilized	192.0	222.0	164.0	197.5	Total Stabilized
Total Paved and Stabilized	211.2	272.7	251.0	307.2	Total Paved and Stabilized

MAG consulted with the jurisdictions to estimate the average weekday traffic on the roads with the unpaved shoulders to be paved or stabilized. The average weekday traffic was multiplied by 0.91 to convert to annual average daily traffic.

The emission factors for paved roads with high silt loadings due to trackout and dragout from dirt shoulders and other sources of fugitive dust were derived from the MAG Silt

Loading Study conducted by the College of Engineering, Center for Environmental Research and Technology, University of California, Riverside (CE-CERT). CE-CERT used state-of-the-art mobile technologies to measure PM-10 concentrations and derive PM-10 emissions rates for paved roads. The SCAMPER (System for Continuous Aerosol Monitoring of Particulate Emissions from Roadways) vehicle collected data on a 104-mile route that was designed to be representative of typical paved road types and sources of fugitive dust in the PM-10 nonattainment area. The SCAMPER vehicle was driven over the entire route during a five-hour period (9:30 a.m. to 2:30 p.m) on 13 weekdays and five weekend days in March, June, September and December of 2006.

The SCAMPER consistently measured much higher PM-10 on some sections of paved road than others on all thirteen of the weekdays. The highest SCAMPER measurements occurred on arterials that had unpaved shoulders and/or unpaved access points from sources such as construction sites, agricultural fields, and sand and gravel operations. Vehicles traveling on or near unpaved shoulders or from unpaved access points to paved roads can trackout dirt or mud from the tires, vehicle undercarriage, or in the wake of the vehicle. The MAG consultants observed during the field work for the PM-10 Source Attribution and Deposition Study that there was frequently visible trackout on the arterials in the Salt River Area that had consistently high PM-10 measured by SCAMPER. They also indicated that the trackout on many roads can be seen by examining satellite photos using Google Earth.

Average PM-10 emissions factors in grams per mile were derived for low volume arterials, other arterials, and freeways, using SCAMPER data on the entire 104-mile route for the13 weekdays. An emissions factor was also developed for the arterials with trackout from the SCAMPER weekday data. The ratio of the emissions factor for arterials with trackout to the average emissions factor for low volume arterials from SCAMPER was applied to the AP-42 emissions factor of 1.70 grams per mile to obtain a trackout emissions factor of 3.51 grams per mile for low volume arterials. The ratio of the emissions factor for arterials with trackout to the average emissions factor for other arterials from SCAMPER was applied to the AP-42 emissions factor of 0.65 grams per mile to obtain a trackout emissions factor of 2.14 grams per mile for other arterials. Since SCAMPER did not measure high PM-10 emissions on the freeways along the 104-mile route, no trackout emissions factor was developed for freeways.

The derivation of the AP-42 emission rates of 1.70 grams per mile for low volume arterials (<10,000 ADT) and 0.65 grams per mile for other arterials ($\geq$ 10,000 ADT) is described in Chapter II in the Section on Reentrained Dust from Paved Roads. To quantify the benefit of paving unpaved shoulders, the average emissions factor for low volume arterials or other arterials (i.e.,1.70 or 0.65) was subtracted from the appropriate trackout emission rate (i.e., 3.51 or 2.14). This difference was multiplied by the linear miles of shoulder to be paved and the AADT on the adjacent paved road. Because linear miles of shoulder represent one side of a road, it was assumed that the reduction in trackout emissions due to paving an unpaved shoulder applies only to traffic moving on the shoulder-side of the centerline (i.e., one-half of the average daily traffic).

The benefit assigned for stabilizing shoulders was 50 percent of the credit for paving. Other data used to quantify the benefits of paving and stabilizing unpaved shoulders are provided in Appendix III, Exhibit 1. The table below summarizes the benefit of commitments by thirteen jurisdictions to pave and stabilize unpaved shoulders in the PM-10 nonattainment area.

PM-10 Emissions Reductions from Paving and Stabilizing Unpaved Shoulders (tons/yr)

Jurisdiction	2007	2008	2009	2010
Maricopa County	12.8	47.1	74.8	102.5
Apache Junction		1.2	1.5	1.5
Cave Creek	2.5	2.5	2.5	2.5
Chandler		51.8	155.5	255.4
El Mirage	2.5	5.0	5.0	5.0
Gilbert	53.4	53.4	53.4	53.4
Glendale		0.7	1.3	1.3
Goodyear			33.4	33.4
Mesa	160.3	160.3	160.3	160.3
Phoenix	33.3	69.5	100.5	129.1
Queen Creek		27.3	70.2	87.3
Scottsdale	115.9	231.9		
Surprise			27.3	27.3
Total	380.7	650.6	685.6	859.0

In addition, SB 1552 requires cities, towns, and counties in Area A to develop and implement plans to stabilize unpaved roads, alleys and shoulders on targeted arterials. The plans are to give priority to shoulders with evident or anticipated vehicle use and must be developed and implemented by January 1, 2008.

Ten jurisdictions have committed to stabilize 198 miles of unpaved shoulders by 2010. It is reasonable to assume that the SB 1552 plans to address stabilization and paving of unpaved shoulders will result in an at least 30 additional miles of shoulders being treated with dust suppressants each year. To allow for implementation of the plans in 2008, the credit for stabilizing 30 miles of unpaved shoulders does not begin until 2009.

The plans are also expected to result in the paving of 15 linear miles of shoulders by December 31, 2008, with another 15 miles to be paved by December 31, 2009. This is a conservative assumption, given that 4 jurisdictions committed to pave 110 linear miles of shoulders by 2010. The average weekday traffic volume on the roads with shoulders to be stabilized or paved is assumed to be one-half of the high traffic volume (i.e., 2,000) identified in the description of Measure #28. The average weekday traffic volume of 1,000 is multiplied by 0.91 to convert to an annual average daily traffic volume of 910 vehicles per day. The results are shown below:

Reductions due to the SB 1552 requirement for plans to stabilize and pave unpaved shoulders

	(tons/yr)	
	2009	2010
Pave 15 linear miles of shoulders by 12/31/08; 30 miles by 12/31/09	9.9	19.9
Stabilize 30 linear miles of shoulders per year, beginning 1/1/09	9.9	9.9
Total reductions due to SB 1552	19.9	29.8

	2007	2008	2009	2010
Total reductions due to measure #28 (tons/yr)	380.7	650.6	705.5	888.8
% reduction in total 2007 PM-10 emissions	0.4%	0.7%	0.7%	0.9%

Measure #30 - Strengthen and Increase Enforcement of Rule 310.01 for Vacant Lots

SB 1552 requires counties in the PM-10 nonattainment area to adopt rules to stabilize disturbed surfaces of vacant lots by March 31, 2008 and begin enforcement by October 1, 2008. It is assumed that this measure will increase compliance with Rule 310.01 for vacant lots by five percent, from 68 percent to 73 percent. The base compliance level of 68 percent was obtained from a rule effectiveness study conducted by MCAQD and documented in the 2005 Periodic Emissions Inventory for PM-10. The control effectiveness for vacant lots of 88.6 percent is derived from the Revised MAG 1999 Serious Area PM-10 Plan, February 2000. The benefit of this measure has been reduced by 75 percent in 2008 to reflect the implementation date of October 1, 2008.

	Base Case	With Measure #30
Rule 310.01 compliance for vacant lots	68.0%	73.0%
Rule 310.01 control effectiveness for vacant lots	88.6%	88.6%
Rule 310.01 effectiveness for vacant lots	60.2%	64.7%

Reductions due to measure #30		(tons/yr)	
	2008	2009	2010
Base case windblown vacant land emissions	5,580	5,580	5,580
Uncontrolled vacant land emissions	14,037	14,037	14,037
Emissions with measure #30	5,425	4,958	4,958
Reductions due to measure #30	155.5	621.8	621.8
% reduction in total 2007 PM-10 emissions	0.2%	0.6%	0.6%

Measure #31 - Restrict Vehicular Use and Parking on Vacant Lots and Measure #32 - Enhanced Enforcement of Trespass Ordinances and Codes

SB 1552 requires cities, towns and counties in the PM-10 nonattainment area to adopt or amend codes/ordinances to restrict vehicle parking and use on unpaved or unstabilized vacant lots by March 31, 2008. In support of Measure #31, Maricopa County Measure 22 commits to adopt ordinance(s) to restrict vehicular use and parking on vacant lots. In support of Measure #32, Maricopa County has also committed to coordinate with the Maricopa County Sheriff's Office to conduct enforcement initiatives which will involve enforcement of ordinances and rules to prevent and discourage vehicle trespass on vacant lots. The County will prioritize the initiatives based on complaints and in areas with high trespass activity.

It is assumed that the enforcement of the strengthened codes/ordinances by Maricopa County and the cities and towns will reduce the emissions from unstabilized lots in the PM-10 nonattainment area by 5 percent in 2008 and 10 percent in 2009 and 2010. The calculation of the benefit assumes that Measures #8, #30, and #33 are already in place. The benefit in 2008 has been reduced by 25 percent to reflect the implementation date for the strengthened codes/ordinances of March 31, 2008 in SB 1552 and Maricopa County Measure 22.

PM-10 emission reductions due to measures #31 & #32	(tons/yr)		
	2008	2009	2010
Vacant lot emissions after implementation of Measures #8, #30, #33	5,269	4,585	4,585
Reductions due to measures #31 & #32	197.6	458.5	458.5
% reduction in total 2007 PM-10 emissions	0.2%	0.5%	0.5%

Measure #33 - Recover Cost of Stabilizing Vacant Lots

SB 1552 authorizes counties in the PM-10 nonattainment area to stabilize the disturbed surface area of vacant lots at the expense of the owner after written notification beginning on October 1, 2008. It is assumed that the ability to recover the cost of stabilization from the land owner will increase compliance with Rule 310.01 for vacant lots by 2 percent from 73 percent to 75 percent. The compliance rate of 73 percent assumes that committed control Measure #30 has been implemented. The benefit of this measure has been reduced by 75 percent in 2008 to reflect the implementation date of October 1, 2008.

	With Measure #30	With Measure #33
Rule 310.01 Compliance for Vacant Lots	73.0%	75.0%
Rule 310.01 Control Effectiveness for Vacant Lots	88.6%	88.6%
Rule 310.01 Effectiveness for Vacant Lots	64.7%	66.5%

	(tons/yr)		
	2008	2009	2010
Controlled vacant land emissions after measure #30	5,425	4,958	4,958
Uncontrolled vacant land emissions	14,037	14,037	14,037
Controlled emissions with measure #33	5,362	4,709	4,709
Reductions due to measure #33	62.2	248.7	248.7
% reduction in 2007 PM-10 emissions	0.1%	0.3%	0.3%

Measure #34 - Increase Fines for Open Burning

SB 1552 requires ADEQ to increase the fine for the first violation for open burning from $25 to $500 in the State of Arizona. SB 1552 also requires counties in Area A to increase the fine for the fourth and subsequent violations of the no burn ordinances from $100 to $250. These increased fines are to go into effect by September 19, 2007. It is assumed that the increased penalties will reduce open burning emissions in the PM-10 nonattainment area by five percent. The base case open burning emissions were obtained from the 2005 Periodic Emissions Inventory for PM-10. The calculation of benefits is shown below.

Base case open burning emissions	24.2	tons/year	
5% reduction in base case open burning emissions		(tons/yr)	
	2008	2009	2010
Reduction due to measure #34	1.2	1.2	1.2
% reduction in total 2007 PM-10 emissions	0.001%	0.001%	0.001%

Measure #35 - Restrict Use of Outdoor Fireplaces and Pits and Ambience Fireplaces in the Hospitality Industry

SB 1552 requires Maricopa County to prohibit by ordinance chimineas and outdoor fires on No Burn Days. This ban is to be implemented by September 19, 2007. During the deliberations on SB 1552, ADEQ provided the legislature with an annual benefit for this measure of 12 tons of PM-10 emissions reduced. This is shown below.

	(tons/yr)		
	2008	2009	2010
Reduction due to measure #35	12.0	12.0	12.0
% reduction in total 2007 PM-10 emissions	0.01%	0.01%	0.01%

Measure #36 - Require Barriers in Addition to Rule 310 Stabilization Requirements for Construction Where All Activity Has Ceased, Except for Sites in Compliance with Storm Water Permits; Measure #37- Reduce the Tolerance of Trackout to 25 Feet Before Immediate Cleanup is Required for Construction Sites be Placed in Maricopa County Rule 310; and Measure #38 - No Visible Emissions Across the Property Line be Placed in Maricopa County Rule 310 and 310.01, and in Local Ordinances for Nonpermitted Sources as Appropriate.

Measures #36-#38 are addressed collectively as Maricopa County Measure 3. For purposes of quantifying the credit for these measures they are called, Strengthen Rule 310 to Promote

Continuous Compliance. It is anticipated that the strengthening of the dust control requirements in Rule 310 will increase compliance by preventing the generation of dust, so that there are fewer incidences of trackout or visible plumes that cause elevated PM-10 concentrations. Due to the implementation of this measure, compliance with Rule 310 is expected to increase by one percent in 2008 and two percent in 2009. The compliance increases are applied after implementation of Measures #2, #3, #9, #10, #16, and #44. In the Maricopa County commitment, the rule changes are scheduled to be implemented by March 2008. The credit for this measure has been reduced by 25 percent in 2008 to reflect the March 2008 implementation date. The calculations are shown below:

Increases in Rule 310 compliance	1% in 2008 (from 59% to 60%)
	2% in 2009 (from 65% to 67%)
	2% in 2010 (from 70% to 72%)

2008-2010 compliance rates assume implementation of M2, M3/16, M9/10/44	2008	w/M36-38	2009	w/M36-38	2010	w/M36-38
Rule 310 compliance	59.0%	60.0%	65.0%	67.0%	70.0%	72.0%
Rule 310 control effectiveness	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
Rule 310 effectiveness	53.1%	54.0%	58.5%	60.3%	63.0%	64.8%

Construction Emissions	2008		2009		2010
after implementation of M2, M3/16, M9/10/44	30,975		26,035		23,212
Uncontrolled construction emissions	62,734		62,734		62,734
Construction emissions w/M36-38	30,552		24,905		22,082
Reduction due to M36-38 (tons/yr)	423		1,129		1,129

(tons/yr)

Reductions by Construction Category After M2, M3/16 & M9/10/44	2008	M36-38 Reduction	2009	M36-38 Reduction	2010	M36-38 Reduction
Residential Construction	9,458	129	7,949	345	7,087	345
Windblown Residential Construction	1,296	18	1,090	47	971	47
Commercial Construction	10,730	147	9,019	391	8,041	391
Windblown Commercial Construction	249	3	209	9	186	9
Road Construction	6,060	83	5,093	221	4,541	221
Windblown Road Construction	18	0	15	1	13	1
Other Land Clearing	3,164	43	2,660	115	2,371	115
Total Construction Emissions	30,975	423	26,035	1,129	23,212	1,129
% reduction in total 2007 emissions		0.4%		1.2%		1.2%

Measure #45 - Prohibit Use of Leaf Blowers on Unstabilized Surfaces

SB 1552 requires counties in Area A to develop and enforce ordinances to prohibit any person from using a leaf blower on unstabilized surfaces by March 31, 2008. It is assumed that 50 percent of leaf blowing currently occurs on unstabilized surfaces and compliance with the ban would be 20 percent. This credit is applied to the net leaf blower emissions after implementation of Measure #21. The emissions reduction benefit of this measure in 2008 has been decreased by 25 percent to reflect the fact that this requirement does not go into effect until March 31, 2008.

	2008 (tons/yr)	2009	2010
Leaf blower emissions with measure #21	903	922	946
Reduction due to measure #45	67.7	92.2	94.6
% reduction in total 2007 PM-10 emissions	0.1%	0.1%	0.1%

Measure #47 - Ban Open Burning During the Ozone Season and Measure #48 - Require Residential Woodburning Ordinances to Include No Burn Restrictions on High Pollution Advisory Days

SB 1552 requires ADEQ to ban outdoor fires in Area A from May 1 through September 30, effective September 19, 2007. During the deliberations on SB 1552, ADEQ provided the legislature with an annual benefit estimate of 6 tons of PM-10 reduced for Measure #47.

In addition, SB 1552 requires counties in Area A to include no burn restrictions on high pollution advisory days that ADEQ forecasts for particulate matter. The latter requirement is to go into effect by October 31, 2007. ADEQ provided the legislature with an annual benefit for this measure of 23 tons of PM-10 reduced for Measure #48.

Reductions due to measures #47 & #48	2008 (tons/yr)	2009	2010
Ban on outdoor fires May through September	6.0	6.0	6.0
No burn restrictions on HPA days for PM	23.0	23.0	23.0
Total reductions due to measures #47 & #48	29.0	29.0	29.0
% reduction in total 2007 PM-10 emissions	0.03%	0.03%	0.03%

Measure #53 - Repave or Overlay Paved Roads with Rubberized Asphalt

The Arizona Department of Transportation (ADOT) has committed to implement Phase X of the Quiet Pavement Program by March 2008. This phase of the program will overlay 2.43 miles of I-10 and 2.78 miles of State Route 143 with rubberized asphalt. ADOT provided the PM-10 emissions reduction of 0.034 tons/lane mile/year for facilities carrying 17,000 vehicles per lane. This reduction is based on research studies conducted by ADOT on the impact of rubberized asphalt pavement on PM-10 emissions. The benefit in 2008 is reduced by 25 percent to account for the March 2008 implementation date.

Quiet Pavement Program - Phase X

Facility	Miles	Lanes	PM-10 Reductions (tons/lane mi/yr)	2008 (tons/yr)	2009	2010
I-10	2.43	10	0.034	0.62	0.83	0.83
SR 143	2.78	6	0.034	0.43	0.57	0.57
Total	5.21			1.04	1.39	1.39
% reduction in total 2007 PM-10 emissions				0.001%	0.001%	0.001%

SUMMARY OF COMMITTED CONTROL MEASURES

Table III-1 summarizes the PM-10 emissions reductions for the committed control measures that have been quantified to meet the five percent reduction requirement of Clean Air Act, Section 189(d). The emissions reductions in Table III-1 were applied to the base case emissions in Table II-2 to obtain the PM-10 emissions with committed control measures shown in Table III-2.

Applying a five percent reduction to the total controlled 2007 PM-10 emissions of 97,436 tons in Table III-2 produces the annual emissions reduction target required by Clean Air Act. The five percent reduction targets of 4,872 tons in 2008, 9,744 tons in 2009, and 14,616 tons in 2010 are shown at the bottom of Table III-1. This table indicates that the cumulative benefits of the twenty-five quantified measures exceed the reduction targets in each of these years. Therefore, the annual five percent reduction requirement of the Clean Air Act is met.

The annual incremental reductions that demonstrate reasonable further progress (RFP) between 2007 and the attainment year of 2010 are shown in Figure III-1. The RFP line represents total PM-10 emissions in the PM-10 nonattainment area after credit is applied for the committed control measures. RFP is defined as incremental emissions reductions sufficient generally to maintain linear progress toward attainment. EPA has recommended that contingency measures should reduce emissions by an amount equivalent to one year of reasonable further progress.

One year of RFP can be calculated by subtracting the 2010 PM-10 emissions of 82,829 tons from the 2007 emissions of 97,436 tons and dividing by three years. This produces an RFP target of 4,869 tons of PM-10 emissions. The next chapter discusses the contingency measures that were quantified to meet this RFP target.

Table III-1. Summary of PM-10 Emissions Reductions for Committed Control Measures

Measure # - Title	PM-10 Reductions (tons/year) 2008	2009	2010
M2 - Extensive dust control training program	564.6	1,693.8	2,258.4
M3/16 - Dust managers/coordinators at earthmoving sites ≥ 5 acres	1,306.5	2,923.4	4,108.8
M9/10/44 - Increase proactive Rule 310 and 316 inspections	1,153.3	3,488.0	4,673.4
M36-38 - Strengthen Rule 310 to promote continuous compliance	423.5	1,129.2	1,129.2
M8 - Conduct nighttime and weekend inspections	1,884.1	3,678.2	4,847.9
M21 - Ban leaf blowers from blowing debris into streets	13.7	18.8	19.3
M45 - Prohibit use of leaf blowers on unstabilized surfaces	67.7	92.2	94.6
M22 - Implement a leaf blower outreach program		0.8	0.9
M23 - Ban ATV use on high pollution days	25.7	26.4	27.1
M25 - Pave or stabilize existing unpaved parking lots	56.4	293.6	418.5
M28 - Pave or stabilize unpaved shoulders	650.6	705.5	888.8
M30 - Strengthen and increase enforcement of Rule 310.01 for vacant lots	155.5	621.8	621.8
M33 - Recover costs of stabilizing vacant lots	62.2	248.7	248.7
M31/32 - Restrict and enforce vehicle use/parking on vacant lots	197.6	458.5	458.5
M34 - Increase fines for open burning	1.2	1.2	1.2
M35 - Restrict use of outdoor fireplaces/pits/ambience fireplaces	12.0	12.0	12.0
M47/48 - Other wood burning restrictions in SB 1552	29.0	29.0	29.0
M53 - Repave or overlay paved roads with rubberized asphalt	1.0	1.4	1.4
Total PM-10 Emissions Reductions for Committed Control Measures	**6,604.6**	**15,422.7**	**19,839.6**
Five Percent Reduction Target (tons/year)	**4,872**	**9,744**	**14,616**

Table III-2. 2007- 2010 PM-10 Emissions with Committed Control Measures (tons/year)

Source Categories	2007	% of total	2008	% of total	2009	% of total	2010	% of total
Stationary point sources	1,792	1.8%	1,841	2.0%	1,867	2.2%	1,904	2.3%
Industrial processes	3,533	3.6%	3,607	3.9%	3,619	4.2%	3,662	4.4%
Fuel combustion & fires	5,665	5.8%	5,643	6.0%	5,663	6.6%	5,683	6.9%
Agriculture	3,559	3.7%	3,416	3.7%	3,281	3.8%	3,152	3.8%
Construction (residential)	11,783	12.1%	10,019	10.7%	7,471	8.7%	6,098	7.4%
Construction (commercial)	12,030	12.3%	10,229	11.0%	7,627	8.9%	6,226	7.5%
Construction (road)	6,659	6.8%	5,662	6.1%	4,222	4.9%	3,446	4.2%
Other land clearing	3,467	3.6%	2,948	3.2%	2,198	2.6%	1,795	2.2%
Travel on unpaved parking lots	3,184	3.3%	3,166	3.4%	3,000	3.5%	2,961	3.6%
Offroad recreational vehicles	2,234	2.3%	2,322	2.5%	2,384	2.8%	2,446	3.0%
Leaf blowers fugitive dust	892	0.9%	835	0.9%	829	1.0%	851	1.0%
Windblown vacant	5,580	5.7%	5,071	5.4%	4,127	4.8%	4,127	5.0%
Windblown other	495	0.5%	495	0.5%	495	0.6%	495	0.6%
Nonroad equipment	1,937	2.0%	1,913	2.0%	1,894	2.2%	1,879	2.3%
Exhaust/tire wear/brake wear	1,719	1.8%	1,668	1.8%	1,587	1.8%	1,537	1.9%
Paved roads (including trackout)	16,373	16.8%	17,018	18.2%	17,901	20.9%	18,718	22.6%
Unpaved roads	16,533	17.0%	17,489	18.7%	17,667	20.6%	17,848	21.5%
Total PM-10 Emissions	**97,436**	100.0%	**93,341**	100.0%	**85,832**	100.0%	**82,829**	100.0%

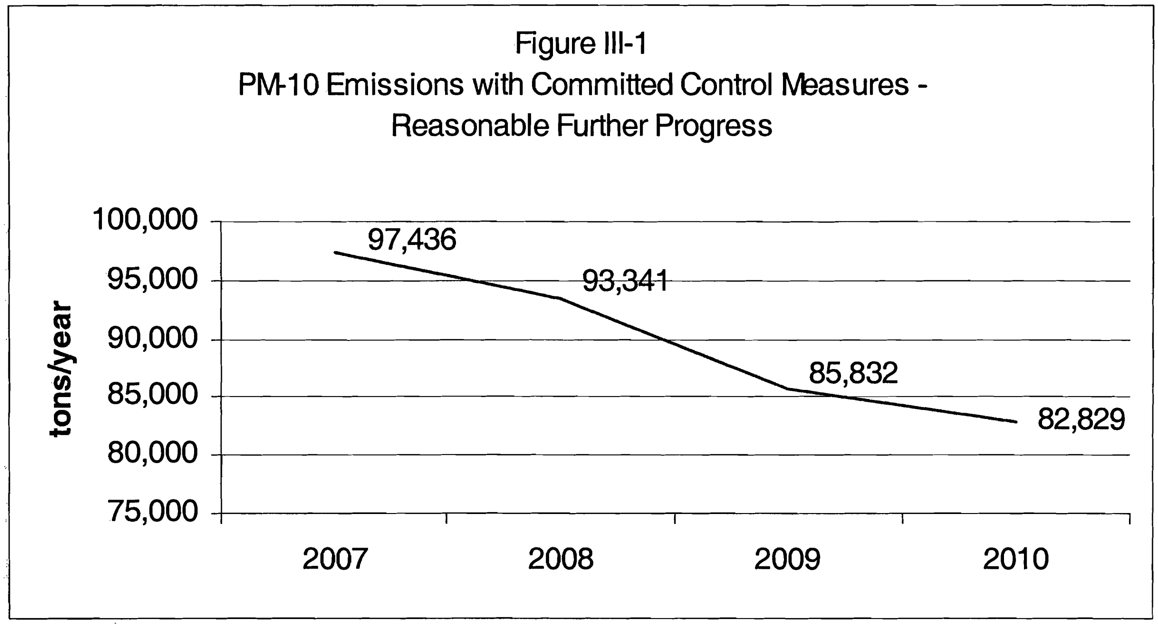
Figure III-1
PM-10 Emissions with Committed Control Measures -
Reasonable Further Progress
tons/year
100,000
95,000
90,000
85,000
80,000
75,000
97,436
93,341
85,832
82,829
2007
2008
2009
2010

IV. EVALUATION OF COMMITTED CONTINGENCY MEASURES

This chapter describes the emissions reduction benefits of the committed contingency measures in the MAG 2007 Five Percent Plan for PM-10. Legally-binding commitments to implement these contingency measures are described in Chapter Six of the Five Percent Plan.

EVALUATION OF INDIVIDUAL CONTINGENCY MEASURES

Nine committed control measures were quantified to meet the contingency requirements of the Clean Air Act. These committed measures were considered to be suitable as contingency measures because credit for these measures was not needed to model attainment in the Salt River Area or at the Higley monitor. The benefits of the contingency measures are calculated after credit is taken for the committed control measures described in the previous section. A detailed discussion of the methods and assumptions used to quantify the benefits of each contingency measure is provided below.

Measure #1 - Public Education and Outreach with Assistance from Local Governments

The media campaign for "Bring Back Blue" was initiated by Maricopa County in January 2007. Based on the sources targeted in the "Bring Back Blue" campaign, it is anticipated that this measure will reduce PM-10 emissions from the following source categories: windblown vacant land, unpaved parking areas, leaf blower dust, offroad recreational vehicles, fugitive dust from paved and unpaved roads, and exhaust, tire and brake wear emissions. Due to the assistance and reinforcement provided in local government commitments to this measure, the benefit is expected to be 0.10 percent in 2008 through 2010. The benefit is applied to the controlled emissions in Table III-2. The detailed calculations are provided below:

Categories of PM-10 emissions reduced by public education and outreach

Controlled PM-10 emissions (tons/yr)	2008	2009	2010
Windblown Vacant Land	5,071	4,127	4,127
Unpaved Parking Areas	3,166	3,000	2,961
Leaf Blower Dust	835	829	851
Offroad Recreational Vehicles	2,322	2,384	2,446
Paved Roads	17,018	17,901	18,718
Onroad Exhaust, Tire/Brake Wear	1,668	1,587	1,537
Unpaved Roads	17,489	17,667	17,848
Total emissions impacted	47,569	47,495	48,487

	2008	2009	2010
% reduction in emissions due to measure #1	0.10%	0.10%	0.10%

Reductions due to measure #1 (tons/yr)	2008	2009	2010

Windblown vacant land	5.1	4.1	4.1
Unpaved Parking Areas	3.2	3.0	3.0
Leaf Blower Dust	0.8	0.8	0.9
Offroad Recreational Vehicles	2.3	2.4	2.4
Paved Roads	17.0	17.9	18.7
Onroad Exhaust, Tire/Brake Wear	1.7	1.6	1.5
Unpaved Roads	17.5	17.7	17.8
Total emission reductions (tons/year)	47.6	47.5	48.5
% reduction in total 2007 PM-10 emissions	0.1%	0.1%	0.1%

Measure #5 - Establish a Certification Program for Dust Free Developments to Serve as an Industry Standard

SB 1552 requires that ADEQ establish a dust-free development program with a voluntary certification process by September 19, 2007. This program will increase compliance with Rule 310 by showcasing developments that practice higher standards for controlling dust before, during and after construction. Due to implementation of this program, the construction emissions are expected to decline by 0.10% in 2008-2010. Credit for Measure #5 is applied after reductions have been taken for all committed control measures that reduce construction emissions.

Reduction in construction emissions 0.10%

Construction emissions after implementation	2008	2009	2010
of all committed control measures	28,858	21,518	17,565
Total reduction due to M5 (tons/yr)	28.9	21.5	17.6

M5 Reductions by Construction Category	2008	2009	2010
Residential Construction	8.8	6.6	5.4
Windblown Residential Construction	1.2	0.9	0.7
Commercial Construction	10.0	7.5	6.1
Windblown Commercial Construction	0.2	0.2	0.1
Road Construction	5.6	4.2	3.4
Windblown Road Construction	0.0	0.0	0.0
Other Land Clearing	2.9	2.2	1.8
Total Emissions Reduction (tons/yr)	28.9	21.5	17.6
% Reduction in 2007 PM-10 Emissions	0.03%	0.02%	0.02%

Measure #19 - Reduce Off-Road Vehicle Use in Areas with High Off-Road Vehicle Activity

The City of Goodyear revised its municipal code on February 13, 2006 to prohibit the operation of vehicles on private land without the written permission of the landowner.

Goodyear has submitted this change in city code as a commitment in the Five Percent Plan. The reduction in off-road vehicle emissions attributable to this commitment is assumed to be proportional to the acres of non-state-owned land in Goodyear that are passive open space or vacant versus the comparable acreage in the PM-10 nonattainment area. The acreages below were derived from a GIS analysis of 2004 MAG land use data.

Reductions in Off-Road Recreational Vehicle Emissions due to the Goodyear Commitment

	Goodyear	PM-10 NA
Acres of passive open space, non-state land	6,945	348,247
Acres of vacant, non-state land[1]	11,771	248,221
Total acres of passive open space and vacant non-state land	18,716	596,468
Reduction in land available for off-road vehicle use in Goodyear	3.1%	
Reduction in ORV emissions assuming a compliance rate of 70%	2.2%	

Applying a 2.2 percent reduction to off-road recreational vehicle (ORV) emissions after credit is applied for Measure #1 results in the following reductions:

Reductions due to Goodyear commitment	PM-10 emissions (tons/yr)			
ORV emissions	2007	2008	2009	2010
after credit for measures #1 and #23	2,283	2,319	2,381	2,444
Reductions due to Goodyear commitment	50.2	50.9	52.3	53.7

In addition to the reductions for the Goodyear commitment, Measure #19 also takes credit for the requirement in SB 1552 that cities and towns in Area A develop and enforce ordinances prohibiting the use of vehicles on unpaved surfaces closed by the landowner. The law requires that the ordinances be adopted and implemented by March 31, 2008.

During the deliberations on SB 1552, the legislature was informed by the Arizona Department of Environmental Quality (ADEQ) that the new municipal ordinances would reduce off-road recreational vehicle use in the PM-10 nonattainment area by 7.5 percent. Using this assumption with a 70 percent compliance rate results in the emissions reductions shown below. The benefit is applied after the reductions due to the Goodyear ordinance. The benefit is reduced by 25 percent in 2009, to reflect the fact that SB 1552 does not require the ordinances to be implemented until March 31, 2008.

Reductions due to ordinances required by SB 1552

	PM-10 emissions(tons/yr)		
Controlled ORV emissions after credit for	2008	2009	2010
measures #1and #23 and Goodyear reductions	2,268	2,329	2,390
7.5% of ORV use is reduced	170.1	174.7	179.2
Reductions with a 70% compliance rate	89.3	122.3	125.5

SB 1552 also requires educational materials to be prepared by ADEQ and provided to buyers and renters of ORVs. No additional credit is taken for this educational outreach program to be implemented by ADEQ by September 19, 2007.

	2007	2008	2009	2010
Total reductions due to measure #19 (tons/yr)	50.2	140.3	174.6	179.1
% reduction in 2007 PM-10 emissions	0.05%	0.2%	0.2%	0.2%

Measure #24 - Sweep Streets with PM-10 Certified Street Sweepers

Emission reduction credit for Measure #24 represents the sum of the benefits from three different sets of sources: (1) commitments made by three cities, one town, and the Arizona Department of Transportation, (2) a SB 1552 requirement that contractors sweeping city streets use PM-10 certified units, and (3) funding for 31 PM-10 certified street sweepers in fiscal years 2007, 2008, and 2009 in the MAG Transportation Improvement Program.

(1) Street sweeper commitments were received from three cities and one town. These jurisdictions have indicated in their commitments that all sweepers in their municipally-owned fleets are already PM-10 certified.

The City of Goodyear commits to require construction contractors to use PM-10 sweepers when building permits are issued and leased sweeping on city parking lots to use PM-10 certified units, effective July 2008.

The Town of Paradise Valley commits to mandate that developers use PM-10 sweepers pursuant to the grading and drainage permit, effective December 2007.

The City of Peoria commits to require that city maintenance contractors use PM-10 certified sweepers by July 2007. The City will also require developers to use PM-10 certified sweepers pursuant to the grading and drainage permit, effective January 1, 2008.

The City of Tempe commits to pursue a requirement for PM-10 certified units in city construction contracts by June 2008.

These commitments are assumed to reduce paved road PM-10 emissions by five percent in the four jurisdictions. The vehicle miles of travel (VMT) in the four jurisdictions was derived from the 2008, 2009 and 2010 MAG traffic assignments using GIS. The share of the VMT in the four jurisdictions, relative to the total VMT in the PM-10 nonattainment area, is 12.01 percent in 2008, 12.14 percent in 2009, and 12.13 percent in 2010. Since paved road emissions are directly correlated with VMT, it is assumed that these four jurisdictions have 12 percent of the paved road emissions in the PM-10 nonattainment area. The resultant reductions in PM-10 emissions due to the street sweeping commitments by the four jurisdictions are shown below:

	(tons/yr) 2008	2009	2010
Paved road PM-10 emissions after Measure #28	17,018	17,901	18,718
Reduction due to commitments by 4 jurisdictions	102.1	107.4	112.3

In addition, the Arizona Department of Transportation (ADOT) committed to require the contractor sweeping state highways in the PM-10 nonattainment area to use PM-10 certified units. ADOT indicated that the contractor is currently using PM-10 certified units for 80 percent of the sweeping in the PM-10 nonattainment area. In the sweeping contract to be awarded on January 19, 2008, ADOT will require the use of PM-10 certified units for 100 percent of the sweeping in the PM-10 nonattainment area.

ADOT provided data on the annual curb miles of freeways and arterials swept and the sweeping frequencies. MAG estimated the annual average daily traffic (AADT) per lane mile using recent traffic count data for freeways, U.S. 60 (Grand Avenue). and SR 87. The emission factors for non-certified and certified sweepers were derived from the equations used to quantify credit for the 31 sweepers in the MAG TIP later in this section. The benefit of the ADOT PM-10 compliant sweeping was reduced by one month (i.e., 1/12) in 2008 to account for the implementation of the new contract requirement on January 19, 2008. The pertinent calculations are shown below.

Increase ADOT contracted sweeping with PM-10 certified units from 80% to 100%

For a 7 day sweeping cycle:

Facility Type	EF for non-certified unit (g/mi)	EF for PM-10 certified unit (g/mi)	Benefit of PM-10 sweeper (g/mi)
Freeways	0.15	0.10	0.04

For a 14 day sweeping cycle:

Facility Type	EF for non-certified unit (g/mi)	EF for PM-10 certified unit g/mi)	Benefit of PM-10 sweeper (g/mi)
Arterials	0.53	0.45	0.08

For a 30 day sweeping cycle:

Facility Type	EF for non-certified unit (g/mi)	EF for PM-10 certified unit (g/mi)	Benefit of PM-10 sweeper (g/mi)
Arterials	0.56	0.52	0.04

State Highways Swept by ADOT Contractor	Curb Miles Swept/Year	New Miles Swept w/PM-10 Units	AADT per Lane Mile	PM-10 Reductions (tons/yr) 2008	2009	2010	Sweeping Frequency
Freeways	68,056	13,611	16,870	10.31	11.25	11.25	7 day cycle
Arterial - US 60	550	110	4,071	0.02	0.02	0.02	30 day cycle
Arterial - SR 87	614	123	4,071	0.04	0.04	0.04	14 day cycle
Total	69,220	13,844		10.37	11.31	11.31	

(2) SB 1552 requires contractors sweeping city streets in Area A to use PM-10 certified sweepers. The law requires this measure to be implemented by cities, towns and counties in Area A by March 31, 2008. It is assumed that this requirement in state law will reduce paved road PM-10 emissions in the PM-10 nonattainment area by an additional one percent. This reduction is calculated on the basis of the net paved road emissions after the reductions attributed to the sweeping commitments in (1) above.

	(tons/yr)		
	2008	2009	2010
Paved road emissions after reductions in (1) above	16,906	17,783	18,595
1% reduction in paved road emissions due to (2)	169.1	177.8	185.9

(3) The FY 2007-2011 MAG Transportation Improvement Program (TIP) included $1.44 million in Congestion Mitigation and Air Quality Improvement (CMAQ) funds to purchase PM-10 certified street sweepers in FY 2007. The FY 2008-2010 TIP included $1.11 million in CMAQ funds for purchasing PM-10 sweepers in FY 2008 and $1.21 million, in FY 2009. Each year, MAG solicits requests from local governments to purchase PM-10 certified street sweepers to replace non-certified units, increase the frequency of sweeping, and expand the area swept in the PM-10 nonattainment area. The local governments are required to provide a match of at least 5.7 percent of the cost of each sweeper funded with CMAQ funds. Based on the programmed funding for PM-10 certified sweepers in FY 2007-2009 of $3.76 million and an average CMAQ funding level of $120,000 per sweeper, it is anticipated that 31 additional PM-10 certified sweepers will be purchased during this three-year period. This is a conservative estimate, as CMAQ funds may become available at the end of each fiscal year to buy additional sweepers that were not funded earlier in the year. There were 103 PM-10 certified sweepers purchased with CMAQ funds in FY 2001-2006, which represents an average of 17 per year.

For the 103 sweepers purchased with CMAQ funds in FY 2001-2006, data on sweeping frequency, lane miles swept, and average weekday traffic per lane mile swept was provided to MAG by the jurisdiction requesting funds to purchase a PM-10 certified sweeper. The agency also identified the functions for the new PM-10 certified sweeper being requested (i.e., replace non-certified sweeper, increase sweeping frequency, and/or expand the area swept). If the sweeping frequency or area was to be increased, the agency provided the frequencies and lane miles to be swept before and after deployment of the new sweeper.

Data provided by the requesting agencies was applied to calculate the average PM-10 emissions reduction for each sweeper purchased with CMAQ funds in FY 2001-2006. The methods used to calculate the benefits of the 103 PM-10 certified street sweepers purchased in FY 2001-2006 are discussed in the section on Reentrained Dust from Paved Roads in Chapter II. The average PM-10 emissions reduction for the 103 sweepers was162.69 kilograms per day per PM-10 certified street sweeper. The detailed assumptions used in calculating the average benefit of the 103 sweepers are provided in Appendix II, Exhibit 4.

In converting from daily to annual reductions, it was assumed that a new PM-10 certified unit would sweep 95 percent of the days during the first year, with the remainder of the time devoted to routine maintenance and holiday downtime. It was also assumed that the rate of utilization (and attendant emission reductions) after the first year would decline by 5 percent per year due to the need for increased maintenance as the equipment ages.

For the 12 PM-10 certified sweepers to be purchased in FY 2007 and deployed by January 1, 2008, a utilization rate of 95 percent was applied. The emission reduction for these 12 sweepers in 2008 is:

12 sweepers x 162.69 kg/day reduction x 365 days x 95% utilization x 1.1023/1000 = 746.2 tons
Total PM-10 emissions reduction in 2008 = 746.2 tons

Nine additional sweepers will be purchased in FY 2008 and deployed by January 1, 2009. The benefits of these new sweepers, assuming 95 percent utilization in 2009, are added to the benefits of the 12 purchased in FY 2007, with the latter reduced to 90 percent utilization:

9 sweepers x 162.69 kg/day reduction x 365 days x 95% utilization x 1.1023/1000 = 559.7 tons
12 sweepers x 162.69 kg/day reduction x 365 days x 90% utilization x 1.1023/1000 = 706.9 tons
Total PM-10 emissions reduction in 2009 = 559.7 + 706.9 = 1,266.6 tons

Ten additional sweepers will be purchased in FY 2009 and deployed by January 1, 2010. Applying the same methodology, the emission reduction benefits of the 31 sweepers purchased in FY 2007, FY 2008 and FY 2009 are:

10 sweepers x 162.69 kg/day reduction x 365 days x 95% utilization x 1.1023/1000 = 621.8 tons
9 sweepers x 162.69 kg/day reduction x 365 days x 90% utilization x 1.1023/1000 = 530.2 tons
12 sweepers x 162.69 kg/day reduction x 365 days x 85% utilization x 1.1023/1000 = 667.7 tons
Total PM-10 emissions reduction in 2010 = 621.8 + 530.2 + 667.7 = 1,819.7 tons

	(tons/yr)		
	2008	2009	2010
Reductions due to CMAQ-funded street sweepers (3)	746.2	1,266.6	1,819.7
Total reductions due to measure #24: (1)+(2)+(3)	1,027.7	1,563.1	2,129.2
% reduction in total 2007 PM-10 emissions	1.1%	1.6%	2.2%

Measure #26 - Pave or stabilize existing public dirt roads and alleys

Maricopa County and eleven cities and towns made commitments to pave or stabilize unpaved roads and alleys in the PM-10 nonattainment area. The miles of unpaved roads and alleys to be paved and stabilized are summarized by jurisdiction, year, and type of commitment in the table below. The centerline miles shown in the table are cumulative. For example, Apache Junction has committed to pave 6 miles of road in 2008 and an additional 8 miles in 2009, for a total of 14 miles paved in 2009 and 2010.

Centerline Miles of Roads and Alleys to be Paved or Stabilized

Jurisdiction	2007	2008	2009	2010	Type of Commitment
Apache Junction		6	14	14	Roads Paved
		2	2	2	Alleys Stabilized
Cave Creek			5	10	Roads Paved
	25	25	20	15	Roads Stabilized
Chandler		10	20	30	Alleys Stabilized
		0.7	0.95	0.95	Roads Paved
		0.25			Roads Stabilized
Fountain Hills		0.15	0.425	0.7	Alleys Paved
Gilbert	2.25	2.25	2.25	2.25	Alleys Stabilized
Goodyear			5.34	5.34	Roads Stabilized
Maricopa County			4.75	9.5	Roads Paved
Mesa	0.7	0.7	0.7	0.7	Roads Stabilized
Phoenix	0.25	3.5	6.5	6.5	Roads Paved
	9	54	72	72	Alleys Paved
Scottsdale	13	13	13	13	Roads Stabilized
	89	89	89	89	Alleys Stabilized
Surprise		3.1	3.1	3.1	Alleys Stabilized
Tempe		0.9	0.9	0.9	Roads Stabilized

Total Paved	9.3	64.4	103.6	113.7	Roads/Alleys Paved
Total Stabilized	130.0	146.2	156.3	161.3	Roads/Alleys Stabilized
Total Paved and Stabilized	139.3	210.6	259.9	275.0	Roads/Alleys Paved and Stabilized

MAG consulted with the jurisdictions to estimate the average weekday traffic on the roads and alleys to be paved or stabilized. The average weekday traffic was multiplied by 0.91 to produce annual average daily traffic (AADT). The PM-10 emission factor for unpaved roads is 666.62 grams per mile. The derivation of this emissions factor is described in Chapter II in the section on Travel on Unpaved Roads. The paved road emissions factor for low volume roads (<10,000 average weekday traffic) is 1.70 grams per mile. The derivation of this factor is described in Chapter II in the section on Reentrained Dust from Paved Roads.

Subtracting the PM-10 emissions factor for paved roads from the factor for unpaved roads and multiplying by the centerline miles to be paved and the AADT provides the benefit of paving an unpaved road or alley. The benefit assigned for stabilizing roads and alleys is 50 percent of the credit for paving. The table below summarizes the benefit of commitments on the part of twelve jurisdictions to pave and stabilize unpaved roads and alleys. Other data used to quantify the benefits of paving and stabilizing unpaved roads and alleys are provided in Appendix IV, Exhibit 1.

PM-10 Reductions Due to Paving and Stabilization of Unpaved Roads and Alleys by Twelve Jurisdictions

Jurisdiction	2007	2008	2009	2010
		(tons/yr)		
Apache Junction		78.1	217.1	346.9
Cave Creek	365.2	365.2	474.7	584.3
Chandler		20.2	33.6	45.8
Fountain Hills		0.9	14.9	28.2
Gilbert	0.6	0.6	0.6	0.6
Goodyear			236.6	236.6
Maricopa County			232.4	464.9
Mesa	2.5	2.5	2.5	2.5
Phoenix	25.0	174.1	254.4	254.4
Scottsdale	385.3	385.3	385.3	385.3
Surprise		3.8	3.8	3.8
Tempe		1.0	1.0	1.0
Total	778.5	1,031.5	1,856.8	2,354.2

In addition, SB 1552 requires that cities, towns, and counties in Area A develop and implement plans to stabilize unpaved roads, alleys and shoulders on targeted arterials. The plans are to give priority to stabilizing unpaved roads carrying more than 100 daily vehicle trips (high ADT) and must be implemented by January 1, 2008.

Nine jurisdictions have committed to stabilize 161 miles of unpaved roads and alleys by 2010. It is reasonable to assume that the plans required by SB 1552 will result in at least 30 additional miles of high ADT unpaved roads being treated with dust suppressants. Since the plans must be implemented by January 1, 2008, the credit for stabilizing 30 miles of unpaved roads begins in 2008.

Six jurisdictions have committed to pave 114 miles of unpaved roads and alleys by 2010. It is reasonable to assume that the plans required by SB 1552 will result in the paving of at least 30 additional miles of high ADT unpaved roads. Credit for paving the unpaved roads is not taken until 2010 in order to allow two years for engineering and construction.

The assumptions for the emissions reduction calculations for the SB 1552 requirement are the same as above (i.e., 666.62 grams/mile for unpaved roads; 1.70 grams/mile for low volume paved roads; and 50% reduction for stabilization). An average weekday traffic volume on the unpaved roads of 125 is assumed, because this is the mid-point between the 100 daily vehicle trips cited in SB 1552 and the 150 ADT threshold in Maricopa County Rule 310.01. Rule 310.01 requires unpaved roads in the PM-10 nonattainment area with more than 150 ADT to be stabilized after June 10, 2004. The average weekday traffic volume of 125 is multiplied by 0.91 to convert to an annual average daily traffic volume of 114 vehicles per day. The reductions attributed to the SB 1552 requirement to develop and implement plans to pave or stabilize unpaved roads and alleys are provided below.

Reductions due to the SB 1552 requirement for plans to stabilize or pave unpaved roads and alleys

	2008 (tons/yr)	2009	2010
Pave 30 miles of dirt road > 100 ADT by 12/31/2009			912.9
Stabilize 30 miles of dirt road in 2008, 2009 and 2010	456.5	456.5	456.5
Total PM-10 reductions due to SB 1552	456.6	456.6	1,369.4

	2007	2008 (tons/yr)	2009	2010
Total emissions reductions due to measure #26	778.5	1,488.0	2,313.3	3,723.6
% reduction in total 2007 PM-10 emissions	0.8%	1.5%	2.4%	3.8%

Measure #27 - Limit speeds to 15 miles per hour on high traffic dirt roads

Four jurisdictions made commitments to reduced speed limits on unpaved roads: Chandler, Maricopa County, Scottsdale and Youngtown. As indicated in Chapter II in the section on Travel on Unpaved Roads, the AP-42 emissions factor for unpaved roads, for vehicles traveling an average of 25 mph, is 666.62 grams per mile.

The PM-10 emissions factors (EF) for the lower speed limits were derived by substituting the lower speed limits for 25 mph. The difference between the PM-10 emissions factors at 25 mph and the lower speed was multiplied by the miles to be posted and the estimated annual average daily traffic (AADT). A compliance rate of 70 percent was also applied to derive the benefit of the lower speed limit.

The miles of unpaved roads to be posted with lower speed limits, the AADT, the emissions factor for the reduced speed, the AADTs, and the resultant reduction in PM-10 emissions are summarized below. The benefit of the Chandler commitment decreases over time, because Chandler has committed to pave 0.95 miles of the 1.2 miles by 2009; credit for paving the 0.95 miles is taken under Measure #26. The Youngtown commitment involves posting 10 mph speed limits on alleys. Because the alleys are already stabilized, the benefit of the lower speed limit is reduced by 50 percent.

Jurisdiction	Miles	AADT	Speed (mph)	PM-10 EF (g/mi)	2007	2008 (tons/yr)	2009	2010
Chandler	1.2	34	15	516.32	0.9	0.3	0.1	0.1
Maricopa County	43.9	155	15	516.32		288.5	288.5	288.5
Scottsdale	15.0	159	15	516.32		101.1	101.1	101.1
Youngtown	8.5	2	10	421.54	0.2	0.5	0.5	0.5
Total reduction due to measure #27					1.0	390.4	390.2	390.2
% reduction in 2007 PM-10 emissions					0.001%	0.4%	0.4%	0.4%

Measure #43 - MAG Allocate Additional Five Million Dollars in FY 2007 Federal Funds for Paving Dirt Roads and Shoulders

In July 2007, the MAG Regional Council approved an additional $5 million in FY 2007 federal funds to be programmed in the FY 2007-2011 Transportation Improvement Program for paving unpaved roads and shoulders. At the same meeting, the MAG Regional Council approved nine paving projects to be funded with the additional $5 million. The federal funds are to be matched on a 50/50 basis by the MAG member agency that submitted the project. The methodologies previously described for paving unpaved roads (Measure #26) and paving unpaved shoulders (Measure #28) were applied to the mileage and average weekday traffic data provided by the requesting agencies to calculate the PM-10 emissions reductions for these nine projects. The AADT was obtained by multiplying the average weekday traffic by 0.91. The AADTs for shoulder paving projects were also reduced by 50 percent to represent traffic on the half of the road adjacent to the shoulder. Although the projects are funded in FY 2007, only one-quarter of the credit is taken in 2008 to allow sufficient time for engineering and construction. The projects and associated reductions in emissions are shown below.

Agency	Paving Project Type	Miles	AADT	PM-10 Emission Reductions (tons/yr) 2008	2009	2010
Buckeye	Dirt roads	2.0	419	56.0	224.0	224.0
Buckeye	Dirt shoulders	9.3	691	1.2	4.7	4.7
Glendale	Dirt shoulders	5.17	7,010	5.4	21.7	21.7
Goodyear	Dirt roads	4.50	166	49.8	199.4	199.4
Phoenix/Maricopa Co	Dirt roads	8.79	116	67.9	271.8	271.8
Phoenix/Maricopa Co	Dirt shoulders	16.47	3,077	9.2	36.9	36.9
Queen Creek	Dirt shoulders	3.0	9,100	4.1	16.4	16.4
Queen Creek	Dirt shoulders	5.50	7,735	6.4	25.5	25.5
Scottsdale	Curb & gutter	6.0	5,733	5.2	20.6	20.6
Totals		60.7		205.2	820.9	820.9

% reduction in total 2007 PM-10 emissions due to measure #43 — 0.2% (2008), 0.8% (2009), 0.8% (2010)

Measure #50 - Require Two Agricultural Best Management Practices

SB 1552 requires that the Agricultural Best Management Practices (BMPs) be expanded from one to two and the area in which the BMPs apply be expanded from the PM-10 nonattainment area to Area A. No credit is taken for the expansion to Area A, because the emissions for the Five Percent Plan represents the PM-10 nonattainment area. The 2005 emissions and percentage reductions for tilling and harvesting and unpaved farm roads were derived from the MCAQD, 2005 Periodic Emissions Inventory for PM-10. The percent reduction for cropland was derived from Table 4-2 of the URS and ERG, Technical Support Document for Quantification of Agricultural Best Management Practices, June 2001. The compliance rate of 80 percent assumed in the URS/ERG report was reduced to 59 percent to be consistent with the rule effectiveness study for the Agricultural BMPs contained in the PEI. It was assumed that the benefit of the second set of BMPs for the three categories (i.e., tilling and harvesting, cropland, and non-cropland) would be at least as effective in reducing PM-10 emissions as the first set of BMPs. The calculations are shown below.

	PM-10 emissions (tons/yr)		
Base case agricultural emissions	2008	2009	2010
Tilling and Harvesting	1,118	1,067	1,018
Travel on Unpaved Farm Roads	783	745	708
Livestock	521	521	521
Windblown Agriculture	994	949	905
Total Agricultural Emissions in PM-10 NA	3,416	3,281	3,152

Agricultural emissions (tons/yr)	2005
Uncontrolled tillage emissions in Maricopa Co	3241.12
Uncontrolled tillage emissions in PM-10 NA	1556.06
Controlled tillage emissions in PM-10 NA	1228.67
Reduction due to one tillage & harvest BMP	21.0%
Uncontrolled harvest emissions in Maricopa Co	166.36
Uncontrolled harvest emissions in PM-10 NA	79.87
Controlled harvest emissions in PM-10 NA	58.99
Reduction due to one tilling & harvest BMP	26.1%
Weighted reduction for 1st tillage & harvest BMP	21.3%
Uncontrolled farm road emissions in Maricopa Co	2175.39
Uncontrolled farm road emissions in PM-10 NA	1044.40
Controlled farm road emissions in PM-10 NA	910.64
Reduction due to 1st non-cropland BMP	12.8%
Reduction due to 2nd tillage & harvest BMP	21.3%
Reduction due to 2nd non-cropland BMP	12.8%
Reduction due to 2nd cropland BMP	30.1%

Application of reductions to agricultural source categories (% reduction)	2008	(tons/yr) 2009	2010
Tilling & Harvesting (21.3%)	238.0	227.1	216.6
Unpaved Farm Roads (12.8%)	100.3	95.4	90.7
Windblown Agriculture (30.1%)	299.3	285.5	272.4
Total reductions due to 2nd set of BMPs	637.6	608.0	579.7
% reduction in total 2007 PM-10 emissions	0.7%	0.6%	0.6%

Reduce Trackout onto Paved Roads

Credit for reducing trackout emissions is attributable to three committed measures in the Five Percent Plan.

Measure #14. Reduce dragout and trackout emissions from nonpermitted sources
Measure #15. Cover loads/haul trucks in Apache Junction
Measure #17. Fully implement Rule 316

No emission reduction credit has been quantified previously for Measures #14, #15, and #17. With the exception of Measure #28, the credit quantified for the other committed control measures did not take into account their impact in reducing trackout onto paved roads. As discussed under Measure #28 in the last chapter, SCAMPER data provided an average PM-10 emission rate for paved roads with high PM-10 due to trackout. Application of the SCAMPER trackout and non-trackout emission rates to VMT for the PM-10 nonattainment area in 2008-2010 resulted in the percentage share that trackout emissions represents of total paved road emissions, as shown in the table below.

The reduction in trackout emissions in the PM-10 nonattainment area due to the impact of these three committed measures is expected to be at least 15 percent in 2008-2010. Before taking the 15 percent reductions in trackout, the base case paved road emissions are reduced by the benefits of all other committed control measures (i.e., Measure #28 and Measure #53) and other committed contingency measures (i.e., Measure #1 and Measure #24). The calculations are shown below.

Reduction in Trackout Emissions - 15% in 2008-2010	(tons/yr)		
	2008	2009	2010
Paved road emissions after Measure #1, #24, #53	16,623.4	17,025.5	17,458.8
Share of paved road emissions due to trackout (from SCAMPER)	54.32%	54.01%	53.59%
Trackout emissions	9,029.6	9,195.1	9,355.6
Trackout emissions after credit for Measure #28	8,379.0	8,489.7	8,466.8
15% reduction in trackout emissions	1,256.9	1,273.4	1,270.0
% reduction in total 2007 PM-10 emissions	1.3%	1.3%	1.3%

SUMMARY OF THE CONTINGENCY MEASURES

The contingency measures and associated emissions reductions for 2008-2010 are summarized in Table IV-1. In the previous chapter, the committed control measures were used to quantify one year of reasonable further progress (RFP) which EPA has recommended as the target for annual reductions by contingency measures (see Figure III-1). Table IV-1 shows the cumulative emissions reductions for the contingency measures in 2008-2010, compared with the contingency measure target of 4,869 tons per year. In each year, the benefit of the contingency measures exceeds the RFP target. Therefore, the contingency measure requirement of the Clean Air Act is met.

Table IV-1. Summary of PM-10 Emissions Reductions for Contingency Measures

Contingency Measures #	Measure Title	PM-10 Reductions (tons/yr) 2008	2009	2010
1	Public education and outreach program	47.6	47.5	48.5
5	Certification program for dust free developments	28.9	21.5	17.6
19	Reduce offroad vehicle use	140.3	174.6	179.1
24	Sweep streets with PM-10 certified sweepers	1,027.7	1,563.1	2,129.2
26	Pave or stabilize existing public dirt roads and alleys	1,488.0	2,313.3	3,723.6
27	Limit speeds to 15 mph on high traffic dirt roads	390.4	390.2	390.2
43	Additional $5M in FY07 MAG TIP for paving roads/shoulders	205.2	820.9	820.9
50	Agricultural Best Management Practices	637.6	608.0	579.7
Multiple	Reduce trackout onto paved roads	1,256.9	1,273.4	1,270.0
Total for All Quantified Contingency Measures		**5,222.5**	**7,212.6**	**9,158.9**
Contingency Measure Reduction Target (tons/year)		**4,869**	**4,869**	**4,869**

V. SALT RIVER AREA MODELING

1. INTRODUCTION

Due to numerous exceedances in November 2005 and 2006, several monitors in the Salt River Area of the Maricopa County nonattainment area did not meet the 24-hour PM-10 standard by the attainment date.[1] This chapter documents the results of a modeling analysis that demonstrates attainment of the 24-hour PM-10 standard in 2010 at monitors located within the Salt River Area.

Insight into which monitors consistently exceeded the 24-hour PM-10 standard is provided in Table V-1-1. It shows that two monitors accounted for 26 out of 31 exceedances recorded in 2005 and 27 out of 33 exceedances in 2006. These monitors, Durango Complex and West 43rd Ave, are located in the Salt River Area, a 29 square mile area that has experienced the highest and most frequent violations of the ambient PM-10 standard. These monitors were the subject of an extensive Arizona Department of Environmental Quality (ADEQ) report entitled, "Revised PM-10 State Implementation Plan for the Salt River Area."[2] That report, referred to hereafter as the Salt River Area TSD (for Technical Support Document), documented the conduct of an intensive air quality monitoring study in 2002, the development of a detailed emissions inventory and an extensive modeling analysis of emission sources and control measure commitments that demonstrated attainment of the ambient PM-10 standard in 2006. While exceedances recorded in 2005 and 2006 mooted the need for EPA review and approval of the Salt River Area Plan, the information assembled in the supporting TSD provided an excellent starting point for developing the Five Percent Plan.

1.1 Approach

PM-10 in the arid Southwest largely consists of coarse particles (i.e., aerodynamic diameter greater than 2.5 microns but less than or equal to 10 microns), which are typically crustal in nature and derive mainly from windblown dust, resuspended road dust (from paved and unpaved roads), unpaved parking lots, disturbed vacant land, mining operations, construction, and agricultural activities (e.g., tilling, harvesting and travel on unpaved farm roads). Other components of particulate matter (PM), such as sulfates, nitrates, and organic and elemental carbons (OC and EC), are typically found in the fine fraction of PM (i.e., aerodynamic diameter less than or equal to 2.5 microns), but can also

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[1] EPA revoked the annual PM-10 standard on September 21, 2006. Therefore, this document addresses attainment of the 24-hour PM-10 standard only.

[2] Revised PM-10 State Implementation Plan for the Salt River Area, Technical Support Document, Air Quality Division, Arizona Department of Environmental Quality, June 2005

Table V-1-1
Summary of PM-10 Measurements
Collected at MCAQD Monitoring Sites
In 2005 & 2006
(24-hour NAAQS)

Site Name	2005			2006		
	Max (µg/m³)	Average 2nd High (µg/m³)	# of Exceedances	Max (µg/m³)	Average 2nd High (µg/m³)	# of Exceedances
Bethune Elementary[a]	198	-	1	140	-	0
Buckeye[b]	169	158	2	272	192	3
Central Phoenix	125	76	0	-	-	-
Central Phoenix[b]	116	104	0	134	99	0
Chandler	130	115	0	-	-	-
Durango Complex[b]	206	200	13	240[c]	183	9
Dysart	76	68	0	67	55	0
Glendale	84	56	0	60	59	0
Greenwood	173	95	1	166	141	1
Higley[b]	142	121	0	170	166	2
Mesa	86	55	0	75	59	0
North Phoenix	81	72	0	79	62	0
South Phoenix	147	107	0	132	100	0
South Scottsdale	121	96	0	76	60	0
West Chandler	94	68	0	77	68	0
West 43rd Ave[b]	233	200	13	260[c]	204	18
West Phoenix	155	103	1	147	122	0

[a] Bethune Elementary School is an ADEQ special purpose monitor located within the Salt River Area.
[b] Indicates a continuous particulate monitor
[c] Indicates an exceptional event.

contribute to coarse PM. Previous analyses of PM-2.5 data in the Phoenix area have shown that mobile source exhaust, burning, and industrial sources are important constituents of PM-2.5. EPA designated Maricopa County as an attainment area for PM-2.5 in September 2005. Local monitoring of co-located PM-10 and PM-2.5 monitors confirms that the PM-2.5 fraction on high PM-10 days is a small fraction of the PM-10 concentrations. Therefore, the PM-10 problem in the Maricopa County nonattainment area is largely attributable to coarse particles, comprised primarily of geologic material.

The first step in understanding PM-10 in the Maricopa County nonattainment area is to identify the important crustal constituents of PM-10. High PM-10 concentrations generally occur in September through March, on days with stagnant or near-stagnant conditions. Due to the lack of wind, the local contribution of PM-10 near the sites that exceed the PM-10 standard is very important. The contribution of specific local sources can be best understood by identifying the potential sources of PM-10 near monitoring sites, assembling meteorological, emissions, and monitoring data; and applying air quality models to evaluate the relationship between PM-10 emissions and concentrations.

To meet the requirements of CAA Section 189(d), MAG is required to prepare a Plan that shows a five percent reduction in emissions per year until attainment of the 24-hour PM-10 standard is achieved at all monitors. Due to the numerous exceedances experienced in 2006, the earliest attainment year that can be achieved is 2009. The modeling analysis presented in this report will demonstrate attainment at all monitors located within the Salt River Area by December 31, 2010. Demonstrating attainment by 2010 ensures that reductions from all new control measures in the Five Percent Plan will be fully implemented in accordance with applicable commitments.

In light of the exceedances recorded in 2005 and 2006, MAG determined that additional information would be needed to prepare an attainment demonstration for the Five Percent Plan. This led to the conduct of an intensive field study in November/December of 2006 in the Salt River Area entitled "PM-10 Source Attribution and Deposition Study." While the report documenting that study has not been completed, the results, which include the insights outlined below, have been incorporated into this analysis. The PM-10 Source Attribution and Deposition Study collected the following data that was used in the modeling of attainment in the Salt River Area:

- *Transport* – Vehicles equipped with PM-10 monitors were used to collect measurements of PM-10 concentrations throughout the Salt River Area. Measurements collected at the boundaries provided insight into possible contributions from upwind transport.

- *Improved Meteorology* – Discussions with Maricopa County led to the collection of wind speed and wind direction measures at five-minute intervals instead of on an hourly basis. This information was used to prepare a back trajectory analysis of wind currents and provide additional insight into the role of transport. A mini SODAR unit was installed at the West 34th monitoring site and used to collect data that could be used to interpret mixing heights on days when the ambient PM-10 standard was exceeded.

- *Traffic Counts* – Measurements of traffic volumes were collected on both arterial and local roads throughout the Salt River Area. The hourly measurements were used to quantify the diurnal distribution of travel activity on days when the ambient PM-10 standard was exceeded.

- *Particle Deposition* – Dust jars were sited in the vicinity of the Durango Complex and West 43rd Ave monitors to collect information the relative contribution of deposition to monitored concentrations.

- *Silt Measurements* – U.C. Riverside was retained to drive a vehicle equipped with PM-10 monitors to measure silt levels on roads throughout the Salt River Area. The measurements were used to determine the relative silt loadings on individual arterial roads.

- *Particle Size Distribution* – A vehicle was equipped with a PM monitor that provides measurements of particle size distribution. Measurements were collected in a variety of locations and used to assess source signatures and significance.

- *Field Observations* – Photographs and video recordings of source contributions and activity throughout the Salt River Area were collected. Activity data were collected for numerous locations to support the estimation of source emissions (e.g., unpaved parking activity, etc.). Contacts were also made with a variety of industry associations to collect data on activity levels during days when the ambient PM-10 standard was exceeded.

The data and insights described above were used to support the conduct of the following analysis steps in this study:

- *Emission Inventory Preparation* – Existing emission inventories specific to the Salt River Area were refined. The existing emission inventories that served as the bases for these refinements were the 2005 inventory[3] compiled by the Maricopa County Air Quality Department (MCAQD) and the 2002 inventory developed for modeling use in the Salt River Area TSD. Both of these inventories were comprehensive with respect to the spectrum of sources included and were current with respect to use of available data. In refining existing emission inventories, effort was focused on those source categories that produced the greatest impacts at the monitors as reported in the Salt River Area TSD. To improve the accuracy of modeling major area source category emissions, actual boundaries of individual area sources were

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[3] 2005 Periodic Emission Inventory for PM-10 for the Maricopa County, Arizona, Nonattainment Area, Maricopa County Air Quality Department, May 2007

used in the modeling input files rather than to uniformly distribute these emissions over 400-meter square grid cells as had been done previously.

- *Air Quality Modeling* – Based on a review of EPA guidelines, MAG determined that AERMOD was the most suitable dispersion model for evaluating hourly source contributions to PM-10 exceedances recorded at the Salt River monitors (i.e., Bethune Elementary, Durango Complex and West 43rd Ave.). EPA adopted AERMOD as a regulatory model on December 9, 2005, as a replacement for ISCST3 (i.e., the model employed in the Salt River Area TSD). Compared with ISCST3, AERMOD contains improved algorithms for dealing with low wind speed (near calm) conditions. As a result, AERMOD can produce model estimates for conditions when the wind speed is less that 1 m/sec.[4],[5] This feature is of particular interest for stagnant conditions that characterize winter months in the Salt River Area. Emission inventories and meteorological datasets representative of design day conditions were prepared and used to generate AERMOD runs. The results were combined with background concentrations to produce estimates of design day concentrations. These values were normalized to the actual design day values. The source-specific contributions (i.e., $\mu g/m^3$) were then forecast to 2010 to account for growth where applicable.

- *Control Measure Analysis* – MAG quantified the benefits of control measure commitments to demonstrate the annual five percent reduction in PM-10 emissions. That effort estimated average reductions for each measure throughout the entire nonattainment area. Using these estimates as a baseline, a separate analysis of the emission reductions attributable to these measures within the Salt River Area was prepared. Key issues considered in the Salt River analysis included local operating conditions, local silt measurements, differential implementation of control measures in areas with high emission densities, etc. The benefits for these measures were quantified in 2010 and applied to the source-specific contributions in that year.

- *Attainment Demonstration* – The source-specific estimates of $\mu g/m^3$ in 2010 were summed for each design day and monitor analyzed. The results were contrasted with the 24-hour PM-10 standard to demonstrate attainment.

Recognizing the difficulty agencies have had in accurately estimating emissions, control measure benefits, and conditions within the Salt River Area, this analysis has employed local measurements where possible. In those cases where local data are not available, conservative assumptions have been employed.

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[4] Revisions to the Guideline on Air Quality Models: Adoption of Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions, U.S. Environmental Protection Agency, Federal Register, Vol. 70, No. 216, p. 68218, Novemenber 9, 2005 (Attachment IV)

[5] User's Guide for AERMET, EPA-454/B-03-002, November 2004

1.2 Chapter Organization

Following this introduction, Section 2 describes the modeling domain, design day conditions, and sources adjacent to monitoring sites. Section 3 presents a description of key findings from the PM-10 Source Attribution and Deposition Study relevant to this analysis. A description of the development of the emission inventory is presented in Section 4. Section 5 describes the air quality model inputs, development of background estimates and model performance for design day conditions. Section 6 presents the results of the control measure analysis for the Salt River Area. A summary of the attainment demonstration is presented in Section 7. Appendix V, Exhibit 1, contains the 2010 emission reductions needed to demonstrate attainment.

2. DESCRIPTION OF MODELING DOMAIN AND DESIGN DAY CONDITIONS

2.1 Design Day Selection

PM-10 monitors in the Maricopa County nonattainment area recorded 30 exceedances of the 24-hour average PM-10 national ambient air quality standard in both 2005 and 2006. Exceedances were recorded at six sites in the nonattainment area over the two-year period: Bethune Elementary, Buckeye, W. 43rd Avenue, Durango Complex, Greenwood, and Higley. The stations recording the highest numbers of exceedances were Durango Complex, with 12 in 2005 and 11 in 2006; and West 43rd Avenue, with 13 in 2005 and 17 in 2006. A tabulation of the exceedance days and the 24-hour average concentrations recorded is presented in Tables V-2-1 and V-2-2 for 2005 and 2006, respectively. Because of the high exceedance frequencies, these two monitoring sites were selected for analysis.
The following primary criteria were applied in selecting the design days for PM-10 modeling:

- Days with high 24-hour PM-10 concentrations that are close to the design value for each monitor; and

- Availability of air quality, emission and meteorological data for the selected days and episode.

The Durango Complex and West 43rd Avenue monitors are located about two miles apart to the north and south, respectively, from the Salt River. The two monitors consistently record the highest PM-10 concentrations in the nonattainment area. The Durango and West 43rd monitors exceeded the 24-hour PM-10 standard on 23 and 30 days, respectively, between 2005–2006. Eighteen of the exceedances at Durango and West 43rd occurred on the same day. Most of the exceedances occurred during the fall and winter of 2005–2006 under low wind and severe inversion conditions.

The dates of December 11-13, 2005, were selected to be modeled with AERMOD to represent these stagnant conditions. On December 12, the West 43rd monitor recorded a 24-hour PM-10 concentration of 233 $\mu g/m^3$, the Durango Complex monitor was 207 $\mu g/m^3$, and the Bethune Elementary monitor registered 198 ug/m^3. On December 13, the West 43rd monitor reading was 167.7 $\mu g/m^3$ and the Durango Complex was 166.0 $\mu g/m^3$. December 11 has been included as a spin up day, since the severe meteorology of this episode appears to have started on that date.

On March 10, 2006, the highest PM-10 concentration at the West 43rd monitor was recorded, a value of 260 $\mu g/m^3$. This exceedance was caused by the prevalence of high winds for many hours; the average wind speed for this day was 9 mph.

Table V-2-1 24-Hour Average NAAQS Exceedances Dates and Measured Concentrations 2005			
Date	PM-10 Conc. (μg/m^3)	Date	PM-10 Conc. (μg/m^3)
Bethune Elementary Monitor		Greenwood Monitor	
December 12	***198.0***	December 12	172.7
Buckeye Monitor		West 43rd Ave Monitor	
June 21	158.0	April 4	172.8
November 18	169.6	November 1	166.5
Durango Complex Monitor		November 2	174.0
November 3	163.8	November 10	166.2
November 17	156.2	November 22	173.4
November 22	189.6	November 23	175.5
November 23	165.0	December 2	195.2
December 1	158.8	***December 12***	***233.0***
December 2	165.0	***December 13***	***167.7***
December 12	***206.8***	December 14	177.1
December 13	***166.0***	December 21	200.6
December 14	181.2	December 22	168.3
December 15	156.4	December 23	156.6
December 21	200.3	West Phoenix	
December 22	179.1	December 12	155.0
December 23	157.5	-	-
Note: Selected design days are highlighted in bold italics.			

V-2-2 **24-Hour Average NAAQS Exceedances Dates and Measured Concentrations** **2006**			
Date	PM-10 Conc. (µg/m³)	Date	PM-10 Conc (µg/m³)
Buckeye Monitor		West 43rd Monitor	
February 13	159	January 10	190
February 14	272	January 11	165
February 17	192	January 12	169
Durango Complex Monitor		January 13	157
January 10	155	January 19	184
January 11	169	February 8	183
January 12	170	February 9	204
January 19	183	***February 15***	***202***
February 9	171	June 6	160
February 15	***157***	November 16	164
December 6	167	November 17	175
December 7	174	November 27	164
Higley Monitor		December 5	173
January 24	170	December 6	160
October 5	166	December 7	160
-	-	December 14	163
-	-	December 15	177
Note: Selected design days are highlighted in bold italics.			

Durango and Greenwood also experienced exceedances on March 10, 2006, of 240 μg/m^3 and 166 μg/m^3, respectively. EPA, however, advised MAG that the PM-10 readings on this day have been flagged as a natural event due to high winds. Therefore, MAG determined that this day would not be modeled in the Five Percent Plan.

Other monitors that exceeded the PM-10 standard in 2005-2006 were Buckeye, Greenwood, Higley, and West Phoenix. The Greenwood and West Phoenix monitors exceeded the standard on one day during this period, December 12, 2005. This is one of the stagnant days that is modeled in the Salt River Area. A rollback model has been applied to demonstrate attainment for these two monitors in 2010. The rollback modeling for the Greenwood and West Phoenix monitors is discussed in Chapter Eight of the Five Percent Plan.

The Buckeye monitor had five exceedance days during the 2005-2006 period. However, the Buckeye monitor is located outside of the western boundary of the PM-10 nonattainment area and therefore, was not modeled for the Five Percent Plan.

During the 2005–2006 period, the Higley monitor exceeded the 24-hour PM-10 standard twice, once on January 24, 2006, and again on October 5, 2006. The exceedance on October 5, 2006 was flagged by EPA as a natural event. Windy conditions on the January 24th date caused disturbed vacant lands in the vicinity of the monitor to emit fugitive dust. To ensure that this monitor does not violate the PM-10 standard in the future, MAG determined that the area surrounding the Higley monitor should be modeled with rollback for the conditions that occurred on January 24, 2006. The Higley rollback modeling is discussed in the next Chapter.

The highest 24-hour PM-10 value recorded under high wind conditions in the Salt River during the 2005–2006 period occurred on February 15, 2006, when West 43rd Avenue recorded a concentration of 202 μg/m^3 (this was after the value recorded on March 10, 2006, was flagged as a natural event). On that date, Durango recorded a value of 157 μg/m^3. AERMOD modeling was conducted to demonstrate that, under the high wind conditions that occurred on February 15, 2006, the Durango and West 43rd Avenue monitors would not exceed the PM-10 standard in the future.

In summary, the following design days were selected for the Salt River Area modeling:

- *December 11-13, 2005 (low wind)* – AERMOD (West 43rd, Durango Complex, and Bethune Elementary monitors);

- *February 15, 2006 (high wind)* – AERMOD (West 43rd and Durango Complex monitors).

In the Salt River Area, the days of December 11-13, 2005, were low wind days with significant inversion conditions. December 12 had the highest 24-hour PM-10 average of

233 μg/m^3 at West 43rd Ave, 207 μg/m^3 at Durango Complex, and 198 ug/m3 at Bethune Elementary. The Greenwood, and West Phoenix monitors also recorded exceedances on this day of 173 and 155 μg/m^3, respectively. Both the West 43rd and Durango Complex monitors experienced exceedances with 24-hour concentrations of 177 and 157 μg/m^3, respectively on the high wind day of February 15, 2006. No other monitors recorded exceedances on this date. Meteorological analysis confirmed that high winds were recorded at both sites during a 6-hour period on this day.

Plots of hourly PM-10 concentrations at the West 43rd Avenue and Durango Complex sites, together with hourly mixing height, recorded on December 12, 2005, are shown in Figures V-2-1 and V-2-2, respectively. Figure V-2-1 shows that the average concentration for the Durango Complex at midnight exceeded 100 μg/m^3 and rose rapidly as anthropogenic activity increased during the morning hours. The peak morning concentration was recorded at 9 am. After that time, the sun angle was sufficient to produce enough ground warming to begin to elevate the mixing height. The concentrations dropped as the mixing height increased and more space was available for dispersion. In contrast to other low wind days, however, the hourly concentrations did not continue to fall as the mixing height increased. Instead, starting at 2 pm, while the mixing height was still increasing, the concentrations started to increase and remained elevated for the remainder of the day. One of the modeling challenges is identifying the underlying cause(s) of this behavior.

Another notable feature of Figure V-2-1 is the strength and persistence of the inversion. The mixing height during the morning hours never exceeded 40 meters and the maximum height achieved during the day barely exceeded 150 meters. Once the ground heating stopped, the mixing height dropped rapidly and concentrations remained elevated during nighttime hours when anthropogenic activity was significantly reduced. The mean wind speed for the entire day averaged less than 1 mile per hour. Clearly, the meteorological conditions on this date were severe and conducive to the high concentrations recorded.

While the mixing height profile at West 43rd tracks the Durango profile, there is a significant difference in the concentrations reported. The peak morning concentration occurs earlier (8 am versus 9 am), then declines for two hours and then increases at the same time the mixing height is rising. This "double hump" during the morning hours is unusual and suggests a localized "event" (i.e., diversion of traffic onto unpaved road shoulders next to the monitor, etc.). A check of the meteorological data shows that wind speeds during the morning hours were uniformly low as the average wind speed through 9 am was 1.2 miles per hour. Following the second peak, the concentrations declined and followed the pattern seen at the Durango Complex. Another modeling challenge was to provide insight into the cause of the morning profile at the West 43rd Avenue monitor.

In summary, the December 11-13 design episode was characterized by very low wind speeds that were typical of many of the 24-hour average PM-10 exceedances during the winter of 2005-2006. The lack of wind velocity needed to transport entrained particulate suggested that impacts at the monitoring sites were due to emissions of predominantly local sources. Early morning peaks at the monitors also suggested that morning paved road traffic might be a significant source driving the exceedance levels.

Figures V-2-3 and V-2-4 display hourly wind speed and concentrations recorded on the high wind day of February 15, 2006. Figure V-2-3 shows that unlike a low wind day, the morning concentrations at Durango remained uniformly low. This is surprising since the wind speeds averaged 2.2 mph from midnight through 9 am. The large increase in the concentrations recorded in the early afternoon tracks the increase in wind speeds, which exceed 15 mph at the peak, and then decline to 8 mph at the end of day. Figure V-2-4 shows a similar pattern at the West 43rd Ave. monitor, except that the characteristic increase in morning concentrations seen under low wind conditions, which does not occur at the Durango Complex, does occur at West 43rd.

Figure V-2-1
Summary of Monitoring Conditions at Durango Complex on the Low Wind Design Day (December 12, 2005)

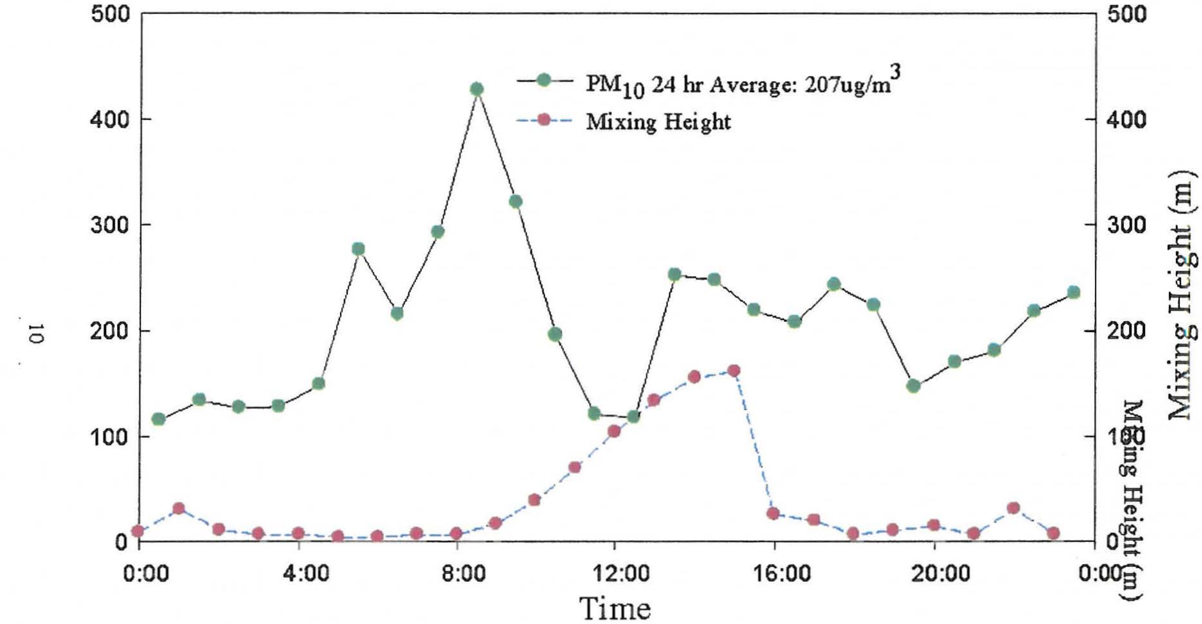


Figure V-2-2
Summary of Monitoring Conditions at West 43rd Ave. on the Low Wind Design Day (December 12, 2005)

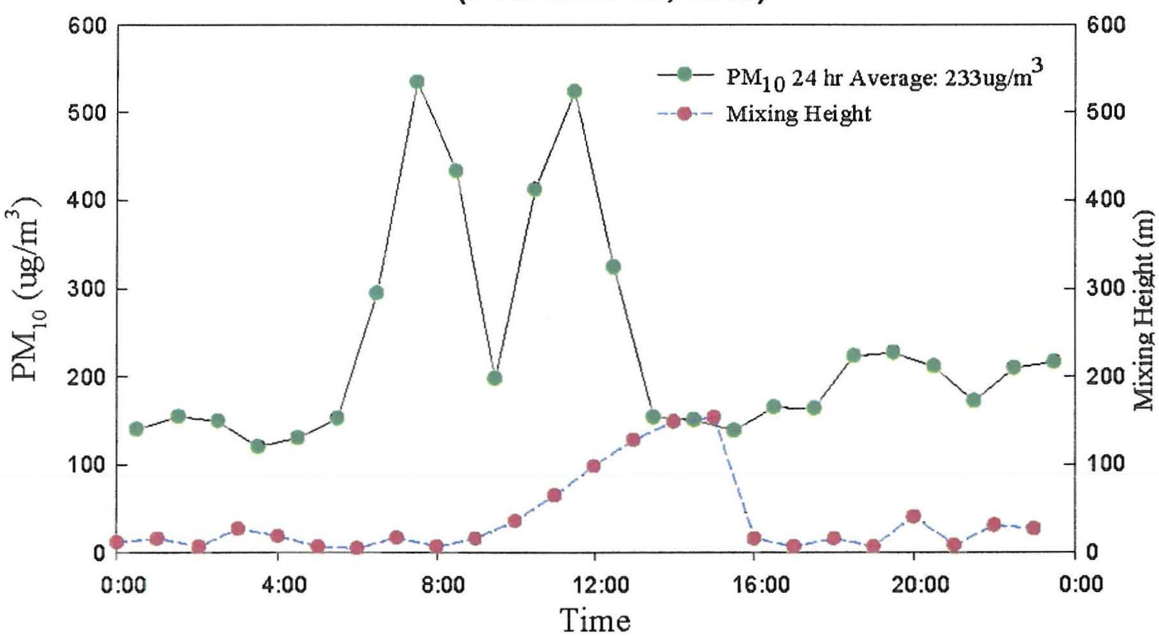


Figure V-2-3
Summary of Monitoring Conditions at Durango Complex on the High Wind Design Day (February 15, 2006)

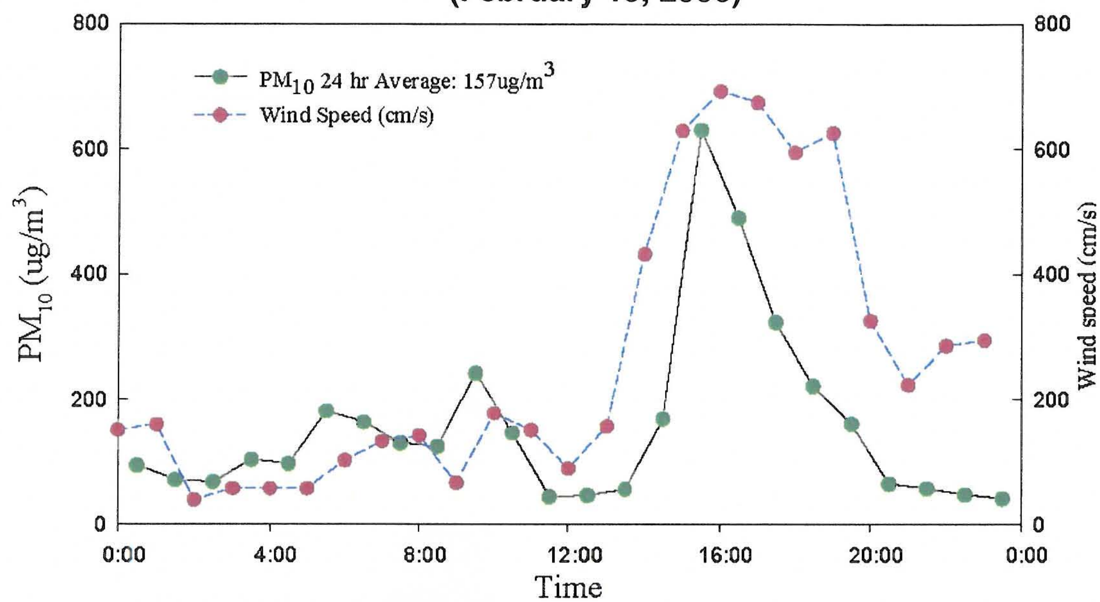
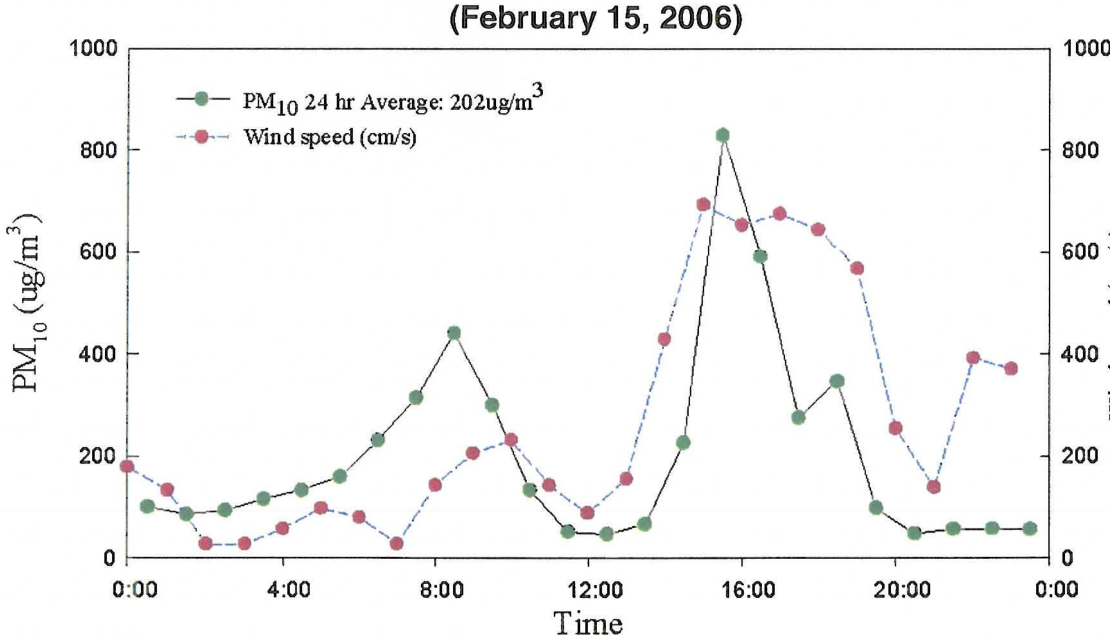


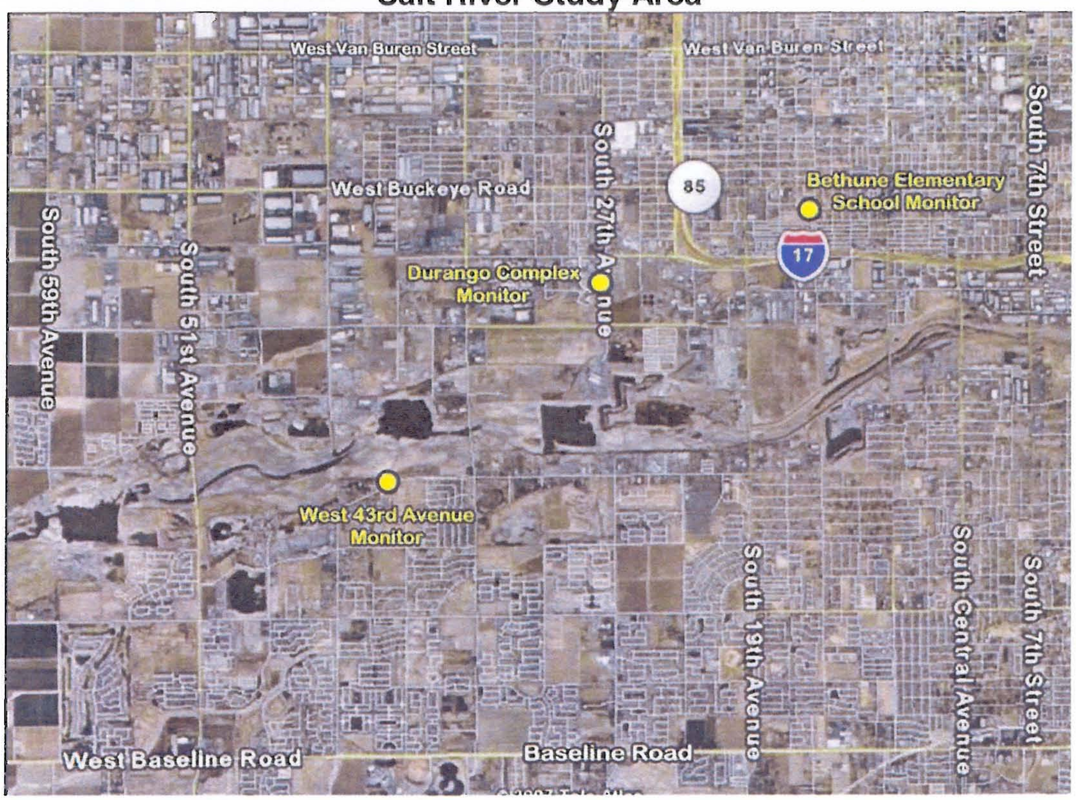
Figure V-2-4
Summary of Monitoring Conditions at West 43rd Ave. on the High Wind Design Day (February 15, 2006)



2.2 Modeling Domain

The modeling domain for the West 43rd Avenue and the Durango Complex monitoring sites is shown in Figure V-2-5. This is the area initially defined in the Salt River Area TSD and is bounded by Van Buren Street to the north, Baseline Road to the South, 59th Ave to the west and 7th Street to the east. Due to the diversity and number of PM-10 sources in the Salt River Area, it is considered to be a worst-case representation of sources throughout the nonattainment area. This area has the highest density of PM-10 emission in the nonattainment area. In addition, all major sources of PM-10 emissions, except unpaved roads, are represented in the area. These sources include light and heavy dust-generating industries, active agricultural land, active construction sites, vacant lots, unpaved parking areas and unpaved road shoulders.

Figure V-2-5
Salt River Study Area



There are four PM-10 monitors located within the modeling domain:

- Bethune Elementary School, which began monitoring on October 19, 2004, for hazardous air pollutants and also employs a dichotomous ambient particulate monitor that provides filter measurements once every six days;
- Durango Complex;
- South Phoenix; and
- West 43rd Ave.

No exceedances were reported at South Phoenix between 2005 and 2006. An exceedance, however, was recorded at the Bethune School on December 12, 2005, with a PM-10 concentration of 198 $\mu g/m^3$. As a result, this study will focus on the three monitors recording exceedances of the 24-hour PM-10 standard (i.e., Bethune School, Durango Complex, and West 43rd Ave.). A brief summary for each is provided below. Figures V-2-6 through V-2-11 provide both area and close up views of the facilities and terrain that surround each of the three monitors.

- *Bethune School* is in the northeast corner of the modeling domain, at the street address of 1310 S. 15th Ave. It is located approximately one-third mile north of I-17, a mile south of Van Buren Street, and 1.5 miles west of 7th Street. While it is surrounded by residences, agricultural fields are located nearby just south of I-17 and a steel plant and related facilities are located less than a mile to the northwest. A complex of riverbed quarries, sand and gravel processing facilities, unpaved truck parking lots, and concrete casting facilities is located to the south.

- *Durango Complex* is located slightly more than a mile and a half to the southwest of Bethune School. The neighboring facilities are considerably more varied as a truck yard is located immediately across 27th Ave to the northeast. A complex of County office buildings is located immediately to the north and open fields are located to the south. The area to the west includes the Maricopa County correctional complex. Nearby to the southeast is agricultural land. I-17 is less than a mile to the northeast. The same complex of riverbed quarries, sand and gravel processing facilities, unpaved truck parking lots, and concrete casting facilities is located to the southeast.

- *West 43rd Ave.* is located in the southwest corner of the modeling domain to the south of the Salt River. A variety of industrial facilities with active unpaved surfaces are located to the west and south. Active sand, gravel processing and concrete casting facilities are located to the south and to the southwest. Alluvial soil from the Salt River is located directly to the north and on the other side of the industrial facilities to the west. A broad region of residential homes and construction activity is located to the south, southwest, and southeast.

Figure V-2-6
Bethune Elementary School Monitor
(Area View)

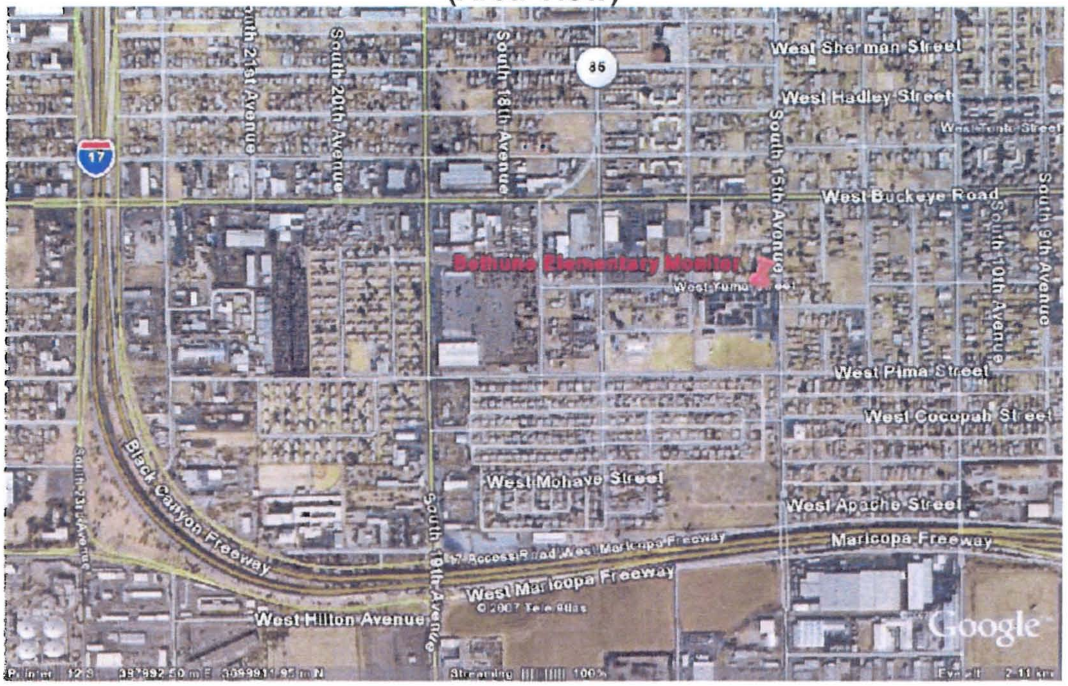


Figure V-2-7
Bethune Elementary School Monitor
(Close Up View)

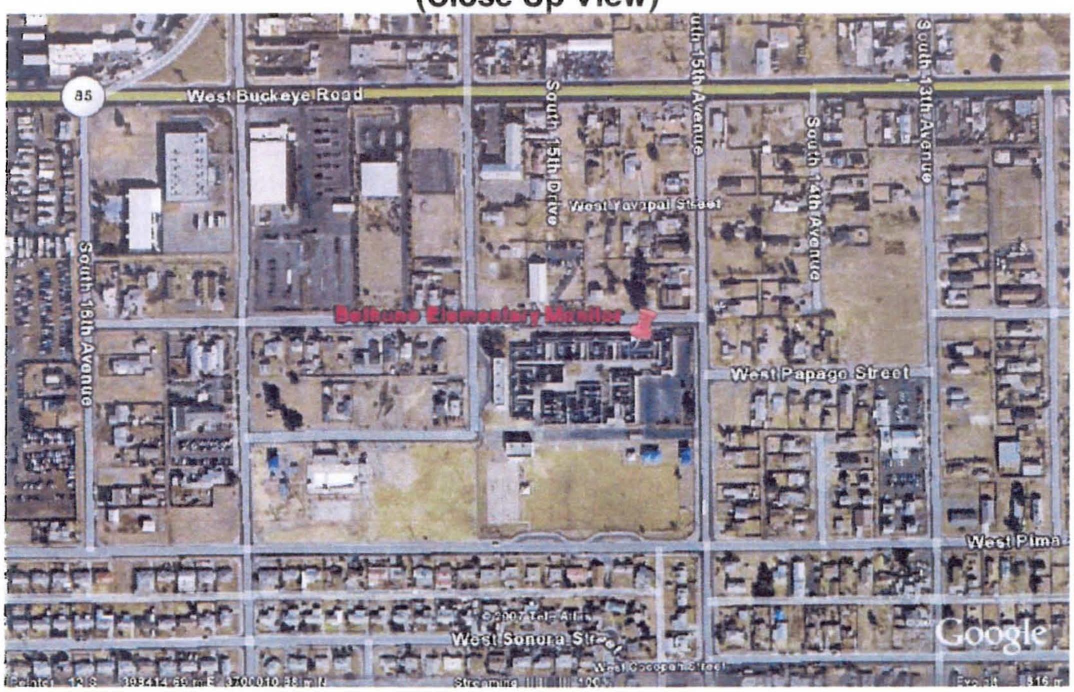


Figure V-2-8
Durango Complex Monitor
(Area View)

Figure V-2-9
Durango Complex Monitor
(Close Up View)

Figure V-2-10
West 43rd Avenue Monitor
(Area View)

Figure V-2-11
West 43rd Avenue Monitor
(Close Up View)

3. LESSONS LEARNED FROM 2006 FIELD STUDY

In light of the exceedances recorded in 2005 and 2006, MAG determined that additional information would be needed to prepare an attainment demonstration for the Five Percent Plan. This led to the conduct of an intensive field study in November/December of 2006 in the Salt River Area entitled "PM-10 Source Attribution and Deposition Study." While the report documenting that study has not been completed, the results, which include the insights outlined below, have been incorporated into this analysis.

3.1 Particle Size Distribution

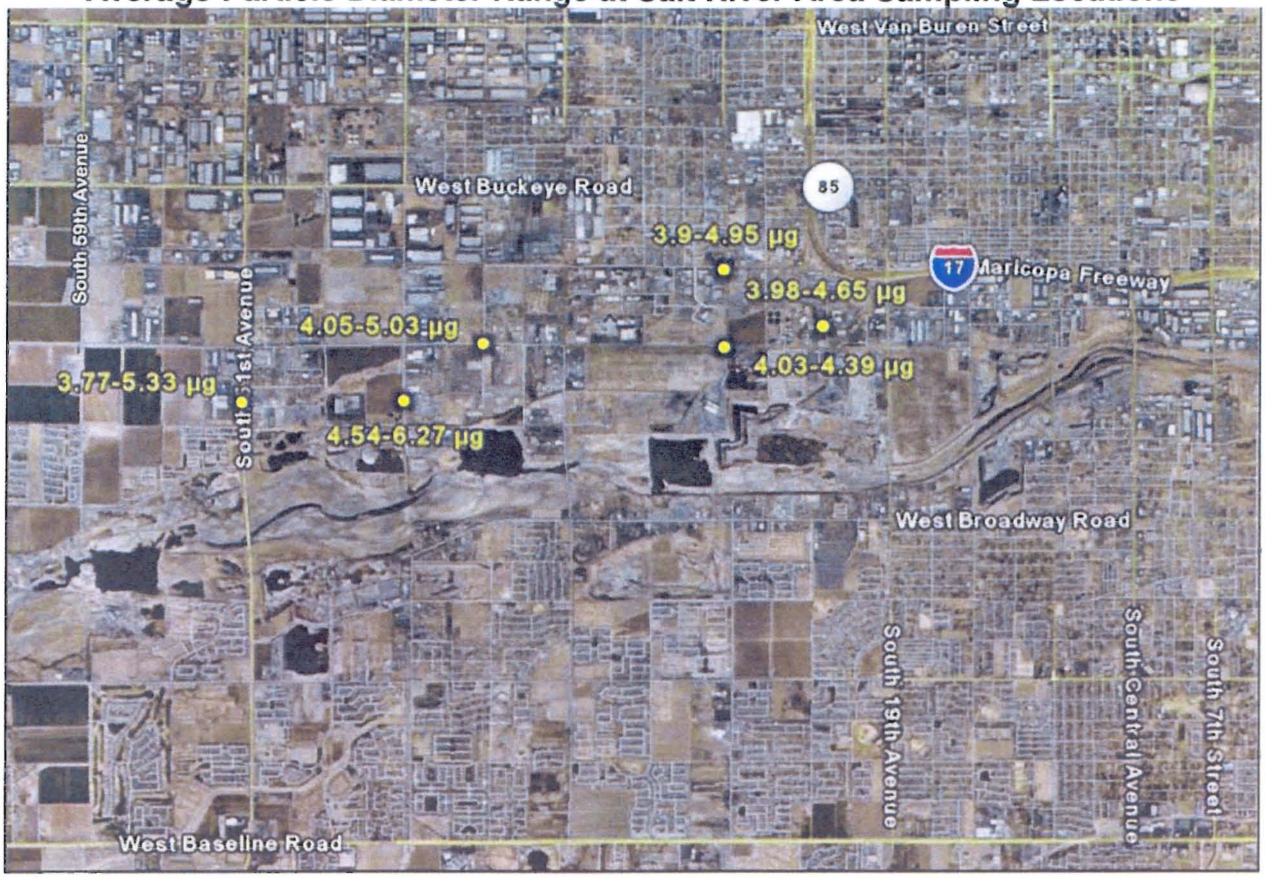
During the December 2006 portion of the intensive Salt River Area field study, the MAG monitoring contractor T&B Systems used a multichannel particle counter to sample ambient particulate concentrations by particle size range. The instrument used to conduct this monitoring, a TSI Aerodynamic Particle Size (APS) Counter, recorded particle counts in 52 diameter ranges extending from 0.5 to 20.0 microns. For this study, only the counts of particles less than or equal to 10 microns were analyzed.

The APS particle counter does not operate well while in motion. As a result, particle counts were only conducted when the T&B vehicle carrying the instrument was stationary at discrete sampling locations. Particle size distributions were measured at several locations in the Salt River Area. These locations included:

- West and east of 51st Avenue near Lower Buckeye Road;
- Downwind of an agricultural tilling operation near 43rd Avenue and Elwood Street;
- North and south of Lower Buckeye Road at 38th Avenue;
- East and south of the Durango Complex monitoring site near 27th Avenue and Durango Street;
- North of Lower Buckeye at 27th Avenue; and
- West of 22nd Avenue near the City of Phoenix Fire Department Training Facility.

A map of these monitoring locations, showing the ranges in average particle diameters recorded at sites near each monitoring location, is shown in Figure V-3-1. The particle size distributions measured at these locations were strikingly similar to each other with one exception. One of three locations downwind of the agricultural tilling operation had a distribution weighted more toward larger particle sizes, probably because this one location—of all of the locations monitored—was directly in the downwind plume of a source with substantial visible dust emissions. The average diameter of particles less than or equal to 10 microns, at locations other than in the agricultural tilling plume, varied between 3.8 and 5.0 microns. The average particle diameter in the tilling plume was 6.3 microns. These results suggest that particles above about 7 microns in diameter settle out of the air relatively quickly in the Salt River and that PM-10 ambient concentrations are dominated by particles from 3 to 7 microns in diameter.

Figure V-3-1
Average Particle Diameter Range at Salt River Area Sampling Locations



This finding indicates that particles producing the majority of mass in PM-10 concentrations measured during low wind periods remain aloft for 1 to 5 hours, thus pointing to local sources as producing the majority of impacts at monitors when wind speeds are less than 1 mile per hour and wind directions meander each hour, which is the predominant meteorological pattern during winter stagnant low wind conditions.

3.2 Mixing Height

Mixing height is a term used to describe the elevation level up to which vertical mixing of air takes place. A low mixing height provides less space for mixing (i.e., dispersion) and increases the potential for pollutant concentrations to rise. A high mixing height provides more space for dispersion and an increased potential for concentrations to decrease.

The Salt River Area TSD relied on soundings taken at the Tucson Airport to characterize mixing height on the same date in the Salt River. For the January 8, 2002 low wind day this produced constant estimates of 178 meters from 1:00am to 7:00am followed by a rapid increase from 8:00am to 2:00pm when the maximum height of 1,367 meters was reached. That value remained constant from 2:00pm to 5:00pm after which reductions gradually lowered the mixing height to 187 meters at midnight.

The method used to estimate ceiling height in this effort was to configure AERMET with meteorological inputs from Tucson on the same date to represent conditions at the Durango Complex and West 43rd monitoring sites. The results for December 5th and 6th in 2006 are displayed in Figures V-3-2 and V-3-3. It shows that in contrast to the Salt River Area TSD, mixing heights remained well below 100 meters from midnight to 8:00am after which ground heating rapidly increased the mixing height to a range of 250-600 meters depending on the day and monitor. Another notable difference from the Salt River Area TSD is the rapid decrease in mixing height once ground heating disappears. The figures show that the mixing height drops to well below 100 meters by 5:00pm for each of the days and monitors displayed. The combination of lower mixing height and elevated anthropogenic activity is potent. As can be seen in the figures, concentrations under low mixing heights in the morning and at night are elevated. In contrast mid day concentrations are relatively low since the increased mixing height provides more space for vertical mixing and dispersion of emissions.

Given the evident relationship between mixing height and concentrations recorded at Durango and West 43rd monitoring sites, it is important to confirm that the mixing height estimates produced by AERMET are correct. Fortunately, a mini SODAR unit was placed adjacent to the West 43rd monitor during the 2006 field study. SODAR units emit a high frequency sound pulse whose reflection time can be used to estimate mixing height. T&B Systems prepared an analysis of SODAR data collected on December 6th.[6] The results are displayed in Table V-3-1.

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[6] Email from Bob Baxter of T&B Systems to Bob Dulla, Sierra Research, September 18, 2007.

Figure V-3-2
Summary of Monitoring Conditions at Durango Complex (December 2006)

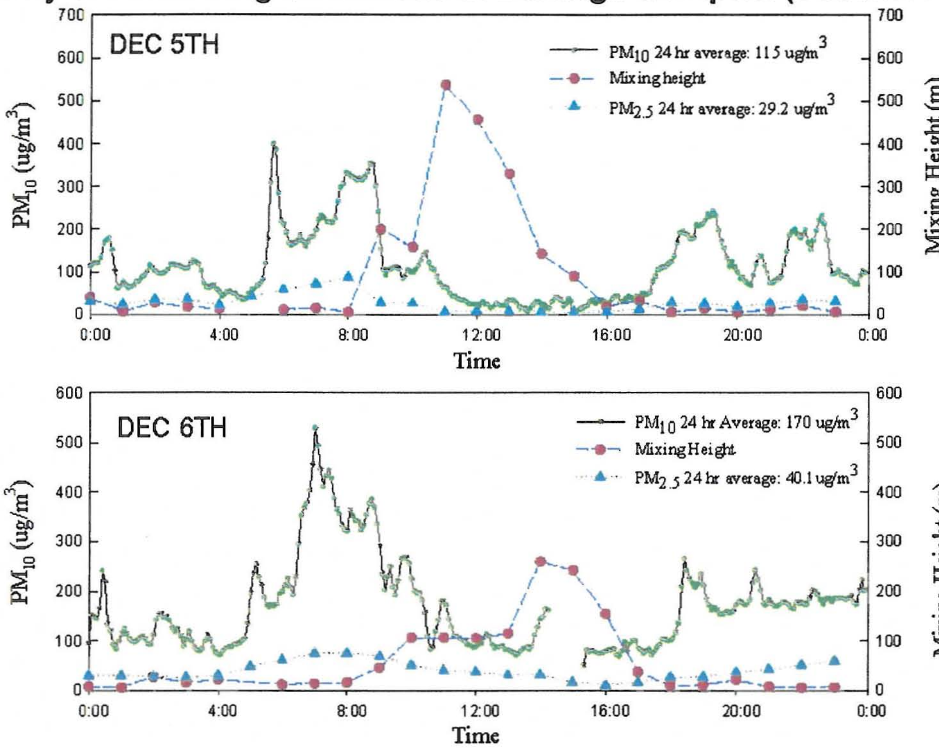

Figure V-3-3
Summary of Monitoring Conditions at West 43rd (December 2006)

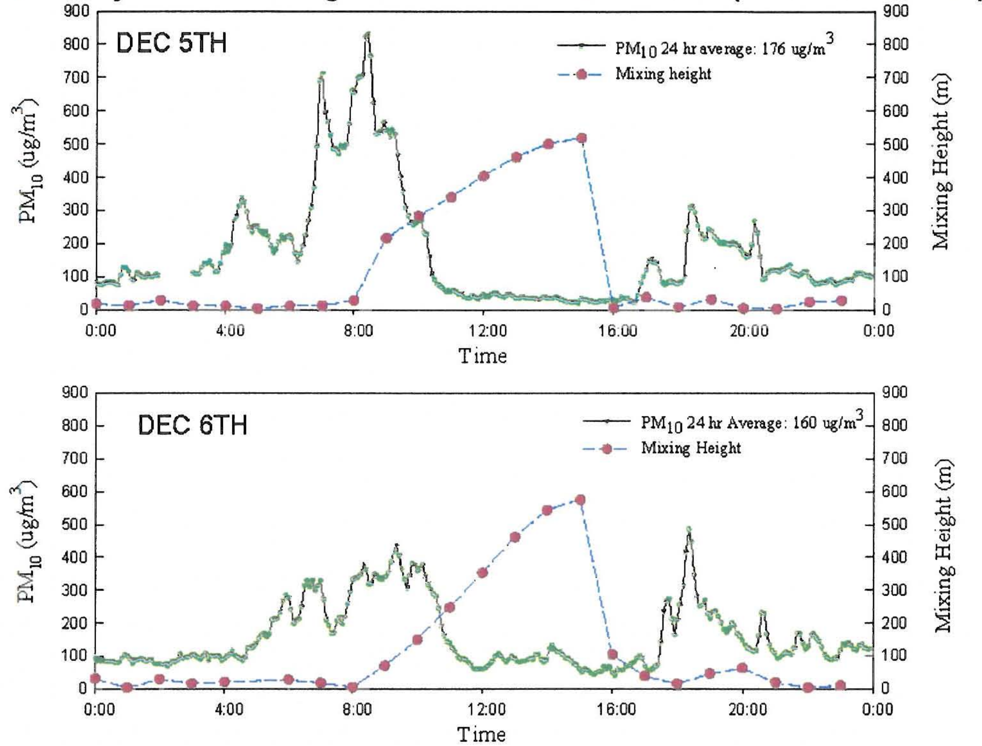

Table V-3-1
Comparison of Mixing Height Values for West 43rd Monitoring Site
December 6, 2006
(meters AGL)

Hour (beginning)	AERMET Prediction	miniSodar Measurement*
01:00	42	25
02:00	46	30
03:00	55	30
04:00	31	40
05:00	32	25
06:00	-999 (missing)	25
07:00	40	30
08:00	21	25
09:00	7	35
10:00	71	55
11:00	149	>90
12:00	249	>85
13:00	353	>90
14:00	462	>90
15:00	545	>75
16:00	577	>75
17:00	114	25
18:00	41	30
19:00	28	40
20:00	51	30
21:00	83	30
22:00	31	25
23:00	26	30
24:00	21	30

* Values listed with the ">" symbol indicate that the mixing height is greater than that value and exceeded the height measurement by the miniSodar.

The good agreement between measured and modeled values confirms the accuracy of the AERMET estimates. It also shows that low mixing height is a principal contributor to the elevated concentrations recorded during low wind days in the Salt River.

In contrast to the low wind days observed in December 2006, the mixing heights for December 12, 2005 were even lower. As can be seen in Figures V-2-1 and V-2-2 (previous section), the mixing heights at both Durango and West 43rd monitoring sites produced by AERMET for those sites follow the same profile found in December 2006. The key difference however, is that during the mid day ventilation period, the mixing heights never exceeded 150 meters. Thus, the drop in mid day concentrations seen in December 2006 is much shorter and less pronounced in December 2005. The result is that concentrations never fell below 100μg/m^3 during the entire 24-hour period at either monitor.

3.3 Particle Deposition

To better understand particle deposition dynamics in the Salt River Area, MAG tasked Sierra with a study of dust fallout near the Durango Complex and W. 43rd Avenue monitors. To conduct this study, particulate matter deposition was monitored using dust fall jars over one week periods at four locations surrounding each monitor by Applied Environmental Consultants (AEC), a subcontractor to Sierra Research. Generally, one jar was placed between the monitor and the nearest arterial road, one monitor was placed on the opposite side of the monitor, and two were placed at other locations of interest near the monitor.

The jars consisted of polyethylene tubs approximately 18 inches in diameter and 6 inches deep, mounted on top of portable wooden stands 6 feet in height. Jars were prewashed with dionized water and transported to and from the sampling locations with plastic covers to avoid contamination or loss of sample during transport. Upon return of each jar to AEC laboratories, the jar was rinsed with dionized water using a rubber policeman to remove particulate from the jar, and the aqueous solution was labeled and stored.

Since the mass of particulate in each solution was very small, the use of standard soil test methods for determining particle size was ineffective. After discussion with several Phoenix-area soils laboratories, Sierra learned of a particle counting method that offered the ability to quantify trace levels of particulate in aqueous solutions by particle diameter range. Particle Measurement Technology in Ventura, California, was retained to conduct particle counts using a laser counting technology. Only a portion of each solution was used in each count, allowing for the use of duplicate counts to quantify instrumental precision. The particle counts were converted to particle mass using standard conversion methods. All particles were assumed to be spherical with an average density of 2.65 grams per cubic centimeter.[7] The results of the jar analyses are shown in Table V-3-2.

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[7] *http://www.ju.edu.jo/ecourse/Lw%20Environment/Materials/lecture%2003.htm*, accessed on October 15, 2006.

Table V-3-2
Size Fraction of Dustfall Collected Near
Durango Complex and W. 43rd Avenue Monitors

Size Range	Durango Complex				W. 43rd Avenue			
	#1	#2	#3	#4	#1	#2	#3	#4
0-2.5 μm	8.0%	7.0%	10.8%	17.2%	18.4%	23.7%	20.7%	9.8%
2.5-5.0 μm	15.5%	15.7%	15.3%	18.1%	18.2%	21.0%	20.4%	17.7%
5.0-7.5 μm	30.3%	31.9%	28.2%	25.9%	26.0%	24.4%	24.9%	31.0%
7.5-10.0 μm	46.2%	45.5%	45.7%	38.8%	37.3%	30.9%	33.9%	41.5%
Mean Dia. μm	5.8	5.3	5.6	6.4	6.6	6.7	6.5	5.9

The size distributions of particles collected by the dustfall jars were weighted more toward coarser particle diameters than the ambient samples analyzed by the T&B Systems APS counter. This could result from the jars being placed closer to significant emissions sources (e.g., arterial roads) than was the case for the APS sampling locations. The distribution of collected mass in the jars shows that the jars nearest arterial roads received more dustfall than those farther away from the roads.

3.4 Travel Activity

MAG hired a contractor to collect vehicle counts at 14 locations throughout the Salt River Area in December 2006. The contractor used axle counts to allocate vehicles to a specific class; no measurements of weight were collected. Vehicle classes were defined as follows:

- Light-duty – 2 axles or less
- Medium-duty – 3 to 4 axles
- Heavy-duty – 5 axles +

Since weight is a key determinant of fugitive dust emissions on paved roads (as it is raised to the 1.5 power in the AP-42 equation) it is important to understand what share of travel comes from medium-and heavy-duty vehicles. Lacking data on the mix of vehicles operating within the modeling domain, which includes a number of aggregate processing and related production facilities, the distribution of vehicle travel was based on travel model estimates provided by MAG. Table V-3-3 presents a comparison of the vehicle mix estimates from the MAG travel demand models and counts taken along the portion of 27th Avenue that is adjacent to the parking lot in which the Durango monitor is located.

Although there is reasonable agreement between the total predicted and measured counts, the vehicle distributions are very different. The travel model significantly underestimates the level of heavy truck activity on 27th Avenue. Similar differences were noted for other arterial roads within the modeling domain. This finding reinforces the importance of using field data, if available, to characterize activity in developing emission inventory estimates for the modeling domain.

Another insight provided by the vehicle count data is the diurnal distribution of travel that occurs on the principal arterials located within the modeling domain. Figure V-3-4 shows the distribution of travel recorded by vehicle type on December 5-7, 2006 for 27th Avenue between Durango and Lower Buckeye. It shows a dramatic rise in traffic during the morning hours. As seen in Table V-3-1, the mixing height does not rise appreciably until 11a.m. This means that the emissions associated with the morning travel activity remain concentrated and will have significant impacts on nearby monitors and receptors.

Table V-3-3
Contrast Between Vehicle Count & Model Predicted Vehicle Mix
On 27th Avenue (between Lower Buckeye and Buckeye)
2005 Forecast versus December 2006 Counts

Hour	Total	Light	Medium	Heavy
Travel Model*				
4am~5am	117	107	4	6
5am~6am	117	107	4	6
6am~7am	572	555	8	8
7am~8am	572	555	8	8
8am~9am	572	555	8	8
Vehicle Count				
4am~5am	110	95	4	10
5am~6am	362	309	10	43
6am~7am	637	519	15	104
7am~8am	614	485	13	116
8am~9am	542	433	13	96

* The MAG's travel model does not produce hourly estimates of travel. Instead, estimates are prepared for periods of the day (e.g., am, pm, etc.). Those estimates must be divided by the # of hours within each period (e.g., the am period covers 3 hours) to produce hourly values, which are the same for each hour within the period represented. Thus, the estimates for the 4 am – 6 am are the same because they come from the nighttime period. Similarly, the estimates for 6am – 9am are the same because they come from the am period.

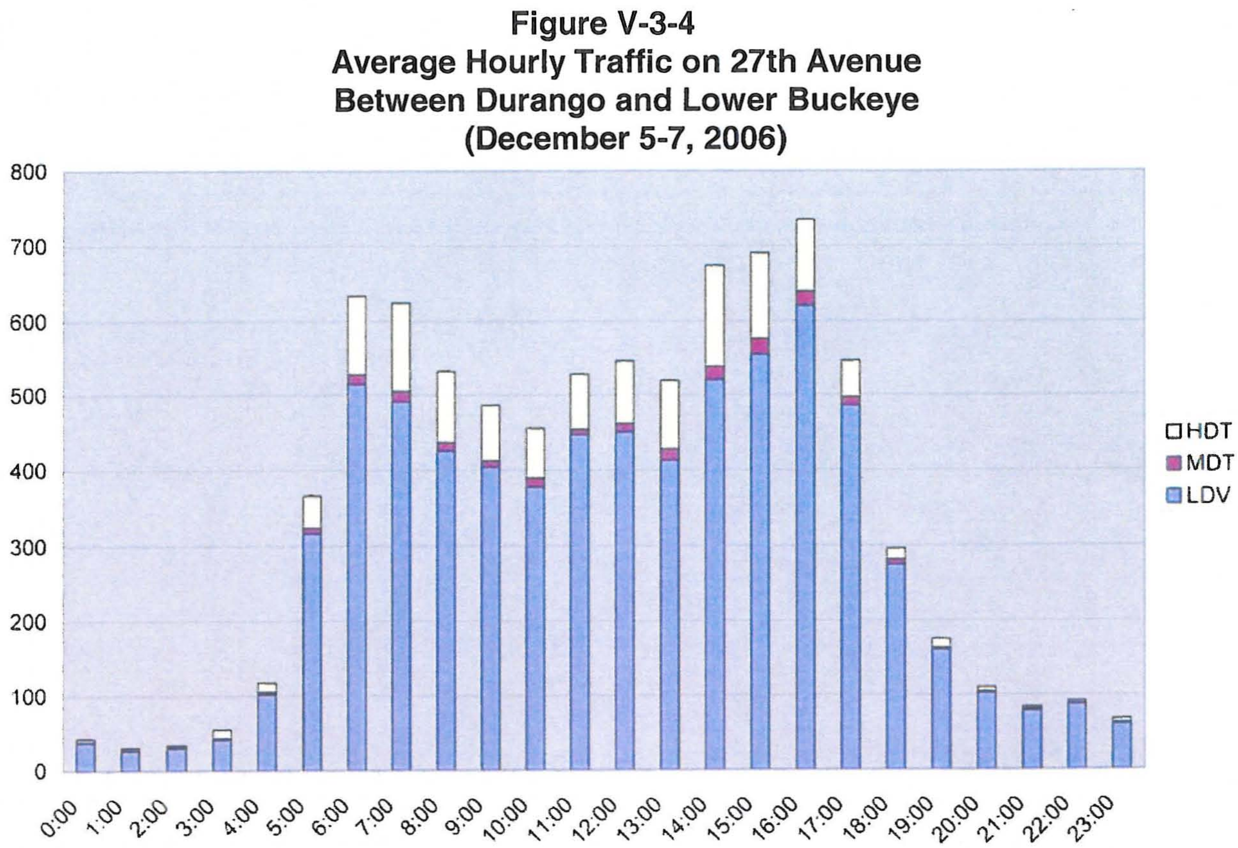


Figure V-3-4
Average Hourly Traffic on 27th Avenue
Between Durango and Lower Buckeye
(December 5-7, 2006)
800
700
600
500
400
300
200
100
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
HDT
MDT
LDV

3.5 Significance of Local Sources

One of the objectives of the field study was gaining insight into the significance of transport on concentrations recorded within the Salt River Area. In part this was because the Salt River Area TSD concluded that background concentrations were responsible for "about half of the measured concentrations within the Salt River PM-10 Study Area." That finding indicated that emission reductions outside of the Salt River Area are just as important as those inside to demonstrating attainment. If, however, a larger fraction of the concentrations impacting the monitors exceeding the ambient PM-10 standard are produced within the modeling domain, it would suggest the need for a different mix of control measures (i.e., one focused more on local control measures). To provide insight into this issue, two different datasets were collected: (1) measurements of PM-10 concentrations throughout the modeling domain and (2) measurements of wind speed and direction both on the ground and aloft. The PM-10 measurements at the boundaries provided insight into the significance of transport from upwind areas outside of the modeling domain. The measurements of wind speed and direction provide the information needed to construct back trajectories of air parcels over time, which in turn provide insight into how long air parcels remain within the modeling domain. Figures V-3-5 through V-3-8 illustrate findings from both datasets.

A summary of PM-10 measurements recorded throughout the modeling domain during the morning hours of November 15, 2006 is shown in Figure V-3-5. It shows that concentrations throughout the Salt River Area are anything but uniform. The highest concentrations were recorded between Central Avenue and 67th Avenue (east to west) and between Buckeye Road and Broadway Road (north to south). Lower concentrations were recorded outside of this area suggesting that transport, particularly from the east may not be a significant issue. Figure V-3-6 presents a summary of measurements collected to the north of the modeling domain. It shows that concentrations north of Van Buren Street were low relative to those observed within the central area of the modeling domain after 8:00am on November 16, 2006. Measurements collected for other periods of the day showed similar results for this area.

Figure V-3-7 illustrates the results of a back trajectory analysis of 5-minute wind speed and wind direction data collected at the West 43rd Avenue monitor on December 6, 2006. It shows that under stagnant conditions, when wind speeds are low and wind direction frequently changes, little of the air impacting the monitor at 9:00am came from outside of the modeling domain. This strongly suggests that background is not a significant source under these conditions.

A similar analysis was constructed from SODAR measurements of winds aloft to address the concern that high concentrations recorded during the morning and then elevated as the mixing height increased might be responsible for deposition later in the day. This analysis however was not a back trajectory, but a forward trajectory, as it documents where the air parcels will be in the succeeding 8-hour period. The results of that analysis are displayed in Figure V-3-8. It shows that in contrast to the low wind conditions recorded at ground

Figure V-3-5
Summary of PM-10 Monitoring Data
(November 15, 2006)

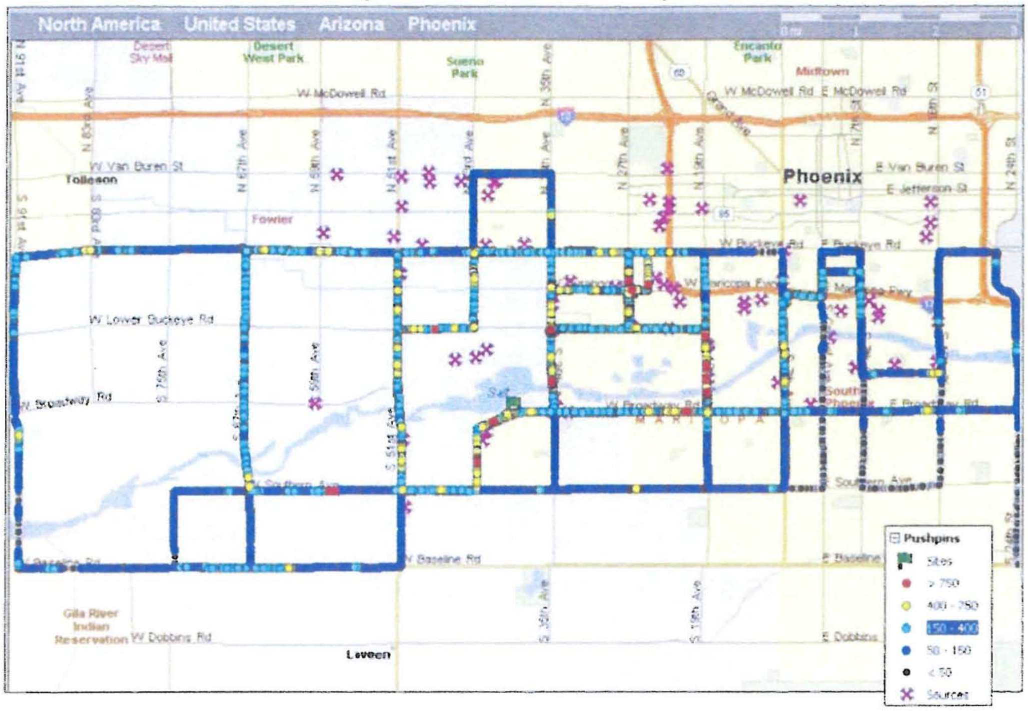


Figure V-3-6
Summary of PM-10 Monitoring Data
(November 16, 2006 – After 8 a.m.)

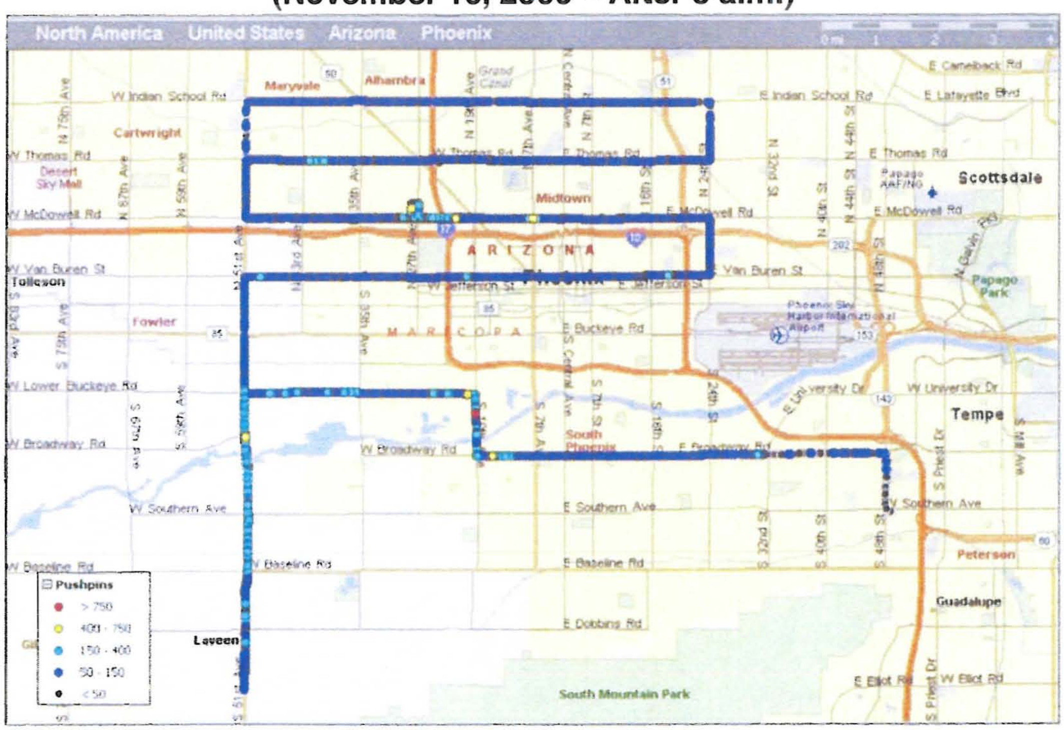


Figure V-3-7
Back Trajectory of Winds Impacting the West 43rd Avenue Monitor
(December 6, 2006 at 9 a.m.)

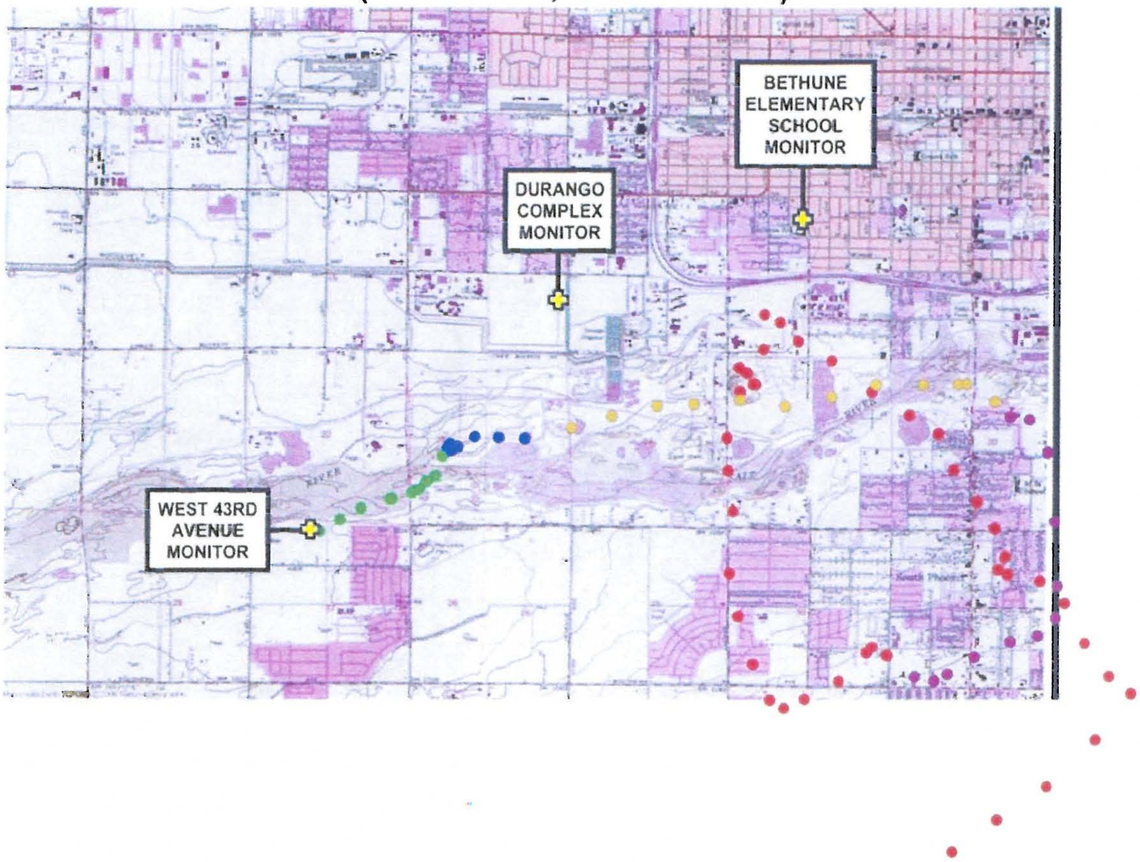
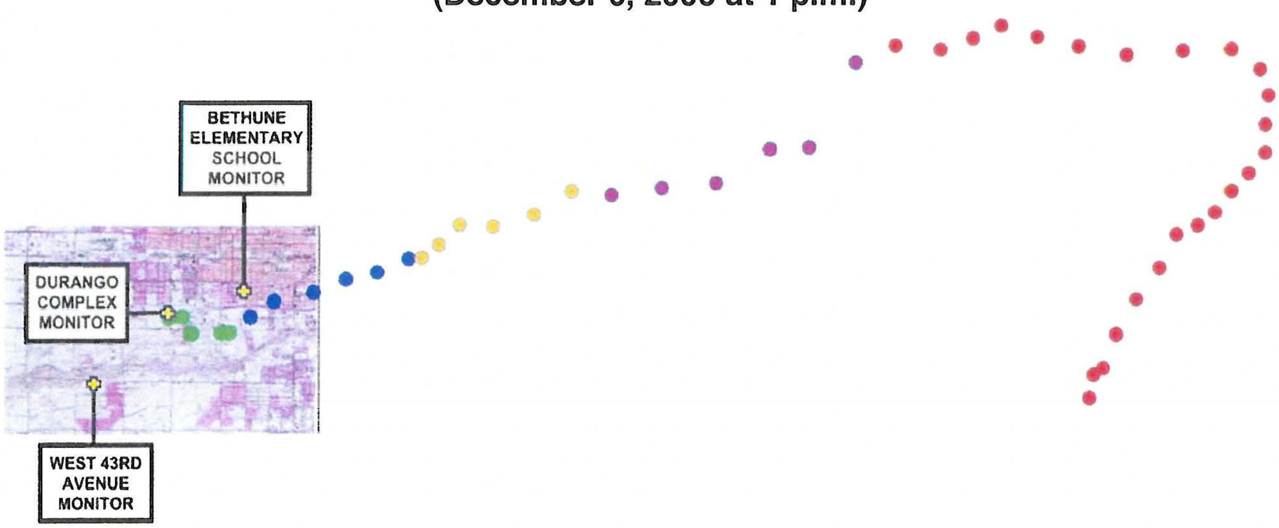


Figure V-3-8
Forward Trajectory of Winds Aloft Starting at the West 43rd Avenue Monitor
(December 6, 2006 at 1 p.m.)



level, the winds aloft are higher and the direction is more consistent. The result is that concentrations elevated with mixing height do not remain within the modeling domain, but instead are transported well outside of the modeling domain. Similar results were seen from forward trajectory analysis of radar data of higher altitude winds. These results collectively confirm that sources inside of the modeling domain are primarily responsible for the emissions causing exceedances of the ambient PM-10 standard under low wind conditions.

3.6 Model Performance

Model performance has been a significant problem for past PM-10 modeling efforts conducted by both MAG and ADEQ. The most recent example was ADEQ's Salt River Area TSD where predicted concentrations only accounted for 20.0 out of 138.6 $\mu g/m^3$ (i.e., 14 percent) on low wind days and 31.4 out of 192.0 $\mu g/m^3$ (16.4 percent) on high wind days. One of the drawbacks of both ISCST and AERMOD, which contributes to the shortfall in predicted concentrations, is the lack of "carry-over" from one hour to the next; another is the lack of information on secondary particulate formation. Another potential cause of underestimating concentrations on low wind days is overestimating mixing heights. Still another is underestimating activity and emissions on a specific design day.

MAG was fortunate to have contractors collecting a variety of activity, meteorological and concentration data on days when Salt River monitors exceeded the ambient 24-hour PM-10 standard in December 2006. Access to this information precludes the need to rely on estimates of many of the parameters needed to prepare the emissions inventories and meteorological data sets needed to perform air quality modeling. Using the collected data, estimates of emissions were only prepared for those sources which impacted the Durango Complex and West 43rd Avenue monitors on the December 6, 2006. A summary of the results of the model predicted concentrations by source category is presented in Figure V-3-9. It shows good agreement between model predicted and monitored values for most hours of the day. Notable shortfalls occurred during the late night and early morning hours when anthropogenic activity is lowest.

A summary of the distribution of sources impacting the monitor (i.e., $\mu g/m^3$) versus emissions produced by those sources (i.e., tons/day) is presented in Figure V-3-10. Not surprisingly, the distributions are different. The modeled values account for the effects of wind direction and dispersion, the inventory values do not. On this date, the principal sources impacting the monitor include traffic, trackout, construction, agriculture and industry. These results, however, are dependent on day-specific activity estimates. When this information is not available and annual/seasonal inventories are the principal data source, the source distribution and monitored impacts will change.

Figure V-3-9
Comparison of Diurnal Distribution of Measured Concentrations and AERMOD Predicted Source Concentrations for Durango Complex (December 6, 2006)

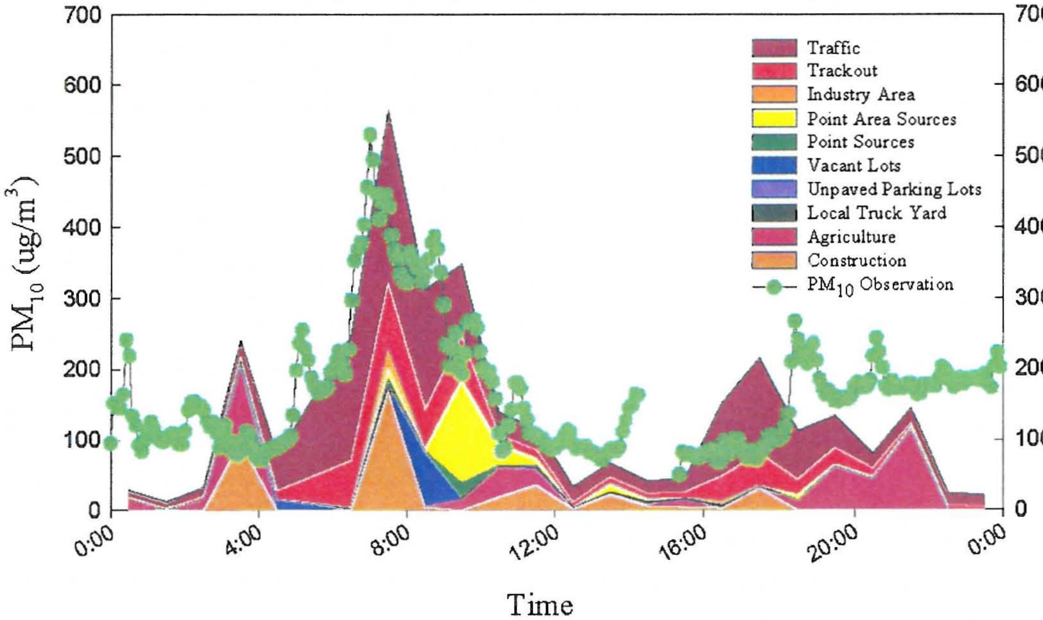
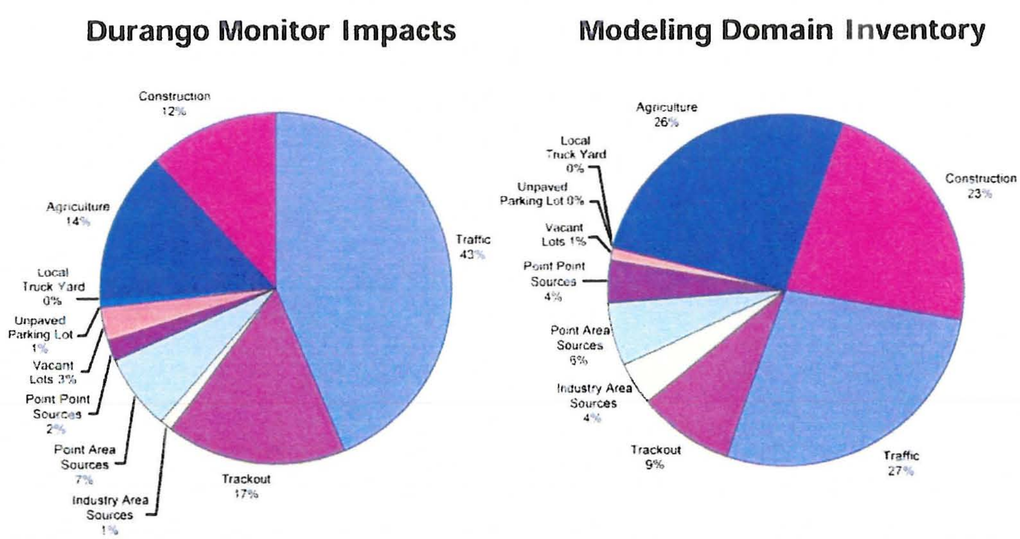


Figure V-3-10
Source Distribution Comparison
Monitor versus Emission Inventory
For the Durango Complex (December 6, 2006)



4. INVENTORY DEVELOPMENT

To enable the use of new source emission information in the modeling analysis of impacts at the Salt River PM-10 monitors, Sierra refined existing emission inventories specific to the modeling domain. The existing emission inventories that served as the bases for these refinements were the 2005 inventory[8] compiled by the Maricopa County Air Quality Department (MCAQD) and the 2002 inventory developed for modeling use in the Salt River Area PM-10 Plan[9] prepared by the Arizona Department of Environmental Quality (ADEQ). Both of these inventories were comprehensive with respect to the spectrum of sources included and were current with respect to use of available data.

In refining existing emission inventories, the MAG contractor, Sierra Research, focused on those source categories that produced the greatest impacts at the monitors as reported in the ADEQ Technical Support Document for the Salt River Area PM-10 (Salt River Area TSD). To improve the accuracy of modeling major area source category emissions, actual boundaries of individual area sources were used in the modeling input files rather than to uniformly distribute these emissions over 400-meter square grid cells as had been done previously. Because stack emission rates in the Salt River Area were small in comparison with area source emissions, Sierra did not update or refine stack emission data as compiled by MCAQD, except to substitute actual daily operating hours on design days for annual average day operating hours.

To the extent possible, Sierra also collected and used activity data specific to each design day for each major source category. During the December 2006 field study period, December 5 through 7 were selected as days for extensive analysis, as the 24-hour PM-10 standard was exceeded at one or both of the Salt River monitors on these days. For these days, actual traffic counts, measured paved road emission factors, actual construction location data, and reported agricultural activity levels, among other data, were used to populate the expanded design day-specific emission inventories.

4.1 Paved Arterial Roads

Paved road fugitive dust emissions is the largest single PM_{10} source category in the Maricopa nonattainment area. The impacts of this category appear to drive the sharp ramp-up of morning emissions on both the low wind and high wind design days when inversion heights are low. As a result, Sierra targeted this source category for significant refinement in the modeling inventory improvement phase.

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[8] 2005 Periodic Emission Inventory for PM-10 for the Maricopa County, Arizona, Nonattainment Area, Maricopa County Air Quality Department, May 2007.

[9] Revised PM-10 State Implementation Plan for the Salt River Area, Technical Support Document, Arizona Department of Environmental Quality, September 2005.

Activity Rates – During the intensive field study of November-December 2006, both activity and emission data were collected on arterial roads within the modeling domain. Activity rates were quantified by the use of traffic counters to measure traffic flows on an hourly basis in each travel direction on arterial streets. Because paved road PM-10 emissions vary with vehicle weight raised to the 1.5 power,[10] vehicle counts were collected in three vehicle class ranges. These ranges included:

- 2-axle vehicles;
- 3- and 4-axle vehicles; and
- 5-axle and greater vehicles.

Vehicle counts were collected on December 4 through December 8, 2006 on 51 arterial road segments in the Salt River Area. Counts for each of the three vehicle axle ranges were recorded for each 15 minute period between 00:00 hours and 24:00 hours. Of these count locations, 28 were used in the modeling analysis. These locations were considered to be significant sources within the modeling domain during low wind conditions.

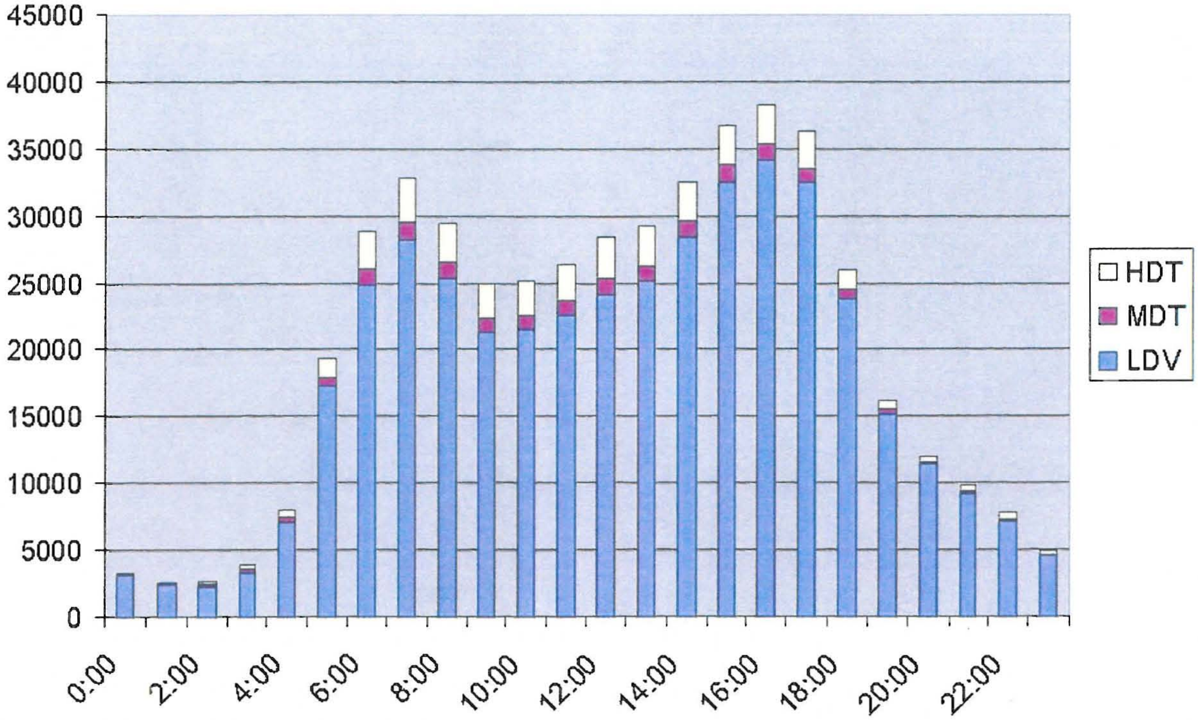
These counts were summed to produce hourly totals on each day. On approximately 20 percent of the road segments, only total vehicle counts were recorded. For these segments, the total counts were disaggregated into counts per vehicle axle range by assuming the fractional distributions on total count segments were the same as adjacent road segments on which vehicle class counts were recorded. The shaded entries indicate the road segments used in modeling analyses.

The diurnal distribution of traffic counts on December 7, 2006, for example, is shown in Figure V-4-1. Each hourly count represents total counts recorded on a subset of 28 road segments on which vehicle emission factors were collected by the SCAMPER system (see below). Total hourly counts over the 28 segments are divided into the three vehicle class ranges to show the diurnal distribution within each vehicle class.

Link-specific VMT estimates were developed for all of the arterial road segments in the Salt River Area. This effort consisted of the construction of a complex spreadsheet that combined period-specific link volumes for morning (AM), midday (MD), afternoon (PM), and nighttime (NT) periods from MAG travel model outputs with hourly travel and VMT mix profiles developed from the December 2006 traffic count study. A detailed lookup table was developed that assigned the "profiles" of hourly traffic and fleet mix tabulated from 15-minute count data collected at the 51 count locations throughout the modeling domain to arterial roadway links within their vicinity. Volumes from each of the roughly 650 arterial modeling links in the domain were first combined into two-way volumes (producing a total of roughly 320 bi-directional links). Then an ArcGIS shapefile layer of the arterial links in

[10] Compilation of Air Pollutant Emission Factors, Volume 1, AP-42, Fifth Edition (Section 13.2.1, 11/06), U.S. Environmental Protection Agency, January 1995.

Figure V-4-1
Diurnal Distribution of Traffic Counts
(December 7, 2006)
December 7, 2006 ADT – All Modeled Road Sections



the domain provided by MAG was used to spatially identify and assign an appropriate count station to each link. Logic was then built into the spreadsheet that apportioned the AM, MD, PM and NT two-way traffic volumes for each arterial link into individual volumes by hour and vehicle type for use in the subsequent dispersion modeling. These hourly VMT calculations were performed for both 2005 and 2010; the 2010 VMT was scaled from the 2005 results using growth projections supplied by MAG.

Emission Factors – As with the MCAQD and ADEQ emission inventories, Sierra used the AP-42 emission factor equation to compute emission factors for paved road travel. This equation, which is produced below, relies on vehicle weight and silt loading for computing fugitive dust emissions.

$$E = k[(sL/2)^{0.65}][(W/3)^{1.5}] - C$$

Where: E = particulate emission factor, grams per mile, g/mi
k = particle size multiplier for particle size range and units of interest, g/mi
sL = road surface silt loading, grams per square meter, g/m^2
W = average weight of the vehicles traveling the road, tons
C = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear, grams per mile, g/mi

For this analysis, paved road fugitive dust emissions were computed in units of grams per mile. AP-42 reports the value of k, the particle size multiplier, as 7.3 g/mi. The vehicle wear emission constant, C, is also reported as 0.21 g/mi. As both fugitive dust emissions and vehicle wear emissions are proportional to traffic levels, and as vehicle wear emissions are small in comparison with fugitive dust emissions in the Salt River Area, a decision was made to ignore the deduction of vehicle wear from vehicle travel emissions to determine fugitive dust emissions. Research has shown the vehicle wear detritus is part of road silt levels, which means that basing fugitive dust emissions on silt measurements and then adding vehicle wear emissions for modeling purposes results in double counting of vehicle wear contributions to some degree.

Silt levels were measured by ADEQ on 43rd Avenue in the Salt River Area on September 29 and 30, 2003. These measurements ranged from 0.4 to 54.3 g/m^2. One of the observations of this study was that the baseline silt level, in the absence of trackout, in the Salt River Area was 0.3 g/m^2. Since Sierra separately quantified and modeled trackout contributions to paved road emissions on discrete road segments, 0.3 g/m^2 was used as the baseline silt level.

During the December 2006 field study, paved road emission factors were measured over several arterial roads in the Salt River Area using the University of California Riverside's System of Continuous Aerosol Monitoring of Particulate Emissions from Roadways (SCAMPER) mobile monitoring platform. The SCAMPER system continuously measures PM-10 concentrations at inlets located on the front bumper and on a trailer following a pickup truck weighting 2.6 tons using DustTrak particle counters. Paved road travel emission factors for this vehicle are computed by multiplying the difference of rear and front inlet concentrations (giving the increase in roadway concentration produced by the vehicle's travel) by the front cross-sectional area of the vehicle (which assumes that the increase in PM-10 concentration is uniform across the vehicle's wake) and the vehicle velocity (to complete the conversion of concentration measurement to mass emission factor). For this project, the continuous measurements taken in both travel directions on each road segment were averaged together to produce road segment-average emission factors.

Statistical analysis of the emission factors recorded by the SCAMPER system during the field study indicate that a baseline emission factor of 0.2 grams per mile was recorded on roads without trackout.[11] For the SCAMPER vehicle weighing 2.6 tons, this emission factor translates to a baseline silt loading of 0.011 g/m^2, which is significantly below any loading measured by the AP-42-recommended sweep sampling method in the Salt River Area. In a recent study conducted in Las Vegas, the SCAMPER was found to underestimate road silt levels in comparison to those measured by swept sample analysis.[12] As a result, the SCAMPER road section emission factors were used in a relative sense to compute true road section emission factors. To do this, it was assumed that a baseline road silt level of 0.3 g/m^2 was present, resulting in an emission factor of 1.72 g/mi for a 2.6 ton vehicle, when the SCAMPER measured a PM-10 emission factor of 0.2 g/mi. Then, the SCAMPER road section emission factors were multiplied by the ratio of 1.72 to 0.2 to convert SCAMPER factors to AP-42-equivalent factors.

The original plan was to use the average vehicle weights within each axle class recorded in the traffic counts to compute paved road fugitive dust emission factors that were road link-specific and axle class-specific. As will be discussed below, the difficulty of estimating average vehicle weights within each axle class was significantly underestimated.

The contractor hired by MAG to collect count measurements used axle count to allocate vehicles to a specific class; no measurements of weight were collected. Vehicle classes were defined as listed below.

- Light-duty – 2 axles or less
- Medium-duty – 3 to 4 axles
- Heavy-duty – 5 axles +

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[11] Email from Cathy Arthur, MAG, to Bob Dulla, Sierra Research, on May 29, 2007.

[12] The Preferred Alternative Method for Measuring Paved Road Emissions for Emissions Inventories: Mobile Technologies vs. the Traditional AP-42 Methodologies, Langston et al, 16th Annual International Emission Inventory Conference, Raleigh, NC, May 2007, *http://www.epa.gov/ttn/chief/conference/ei16/session11/langston.pdf*, accessed on October 27, 2007.

Obtaining representative weights for these classifications is problematic since the range of possible weights within each class can be quite broad, particularly for the heavy-duty classification. EPA uses gross vehicle weight ratings (GVWR) to define 26 different truck classifications. Two additional categories are based on passenger car definitions. None of these categories include information on axles. The Federal Highway Administration (FHWA) employs a vehicle classification system that defines 13 separate classes based on axle count, vehicle configuration and in some cases the number of tires. It, however, provides no information on vehicle weight.

GVWR ratings are not useful for calculating fugitive dust since they define the upper limit or maximum design weight of vehicles. Emission estimates based on these weights would be biased extremely high since they would be based on the assumption that all vehicles are constantly driven with maximum cargo and passenger loads. The key to obtaining representative estimates of vehicle weight that are correlated to axles is to find field measurement systems that collect both axle counts and vehicle weight.

States typically collect this information with weigh-in-motion (WIM) technology, weigh stations or through special studies. Unfortunately, essentially all of this data is collected on freeways. The vehicle mix and weight of vehicles operating on freeways is fundamentally different than the mix of vehicles operating on arterial and local roads. For this reason, correlations between axle count and vehicle weight are not useful for representing vehicles operating within the Salt River Area.

As part of the search for representative data, Sierra contacted the Arizona Department of Transportation (ADOT) to determine if weight data has been collected for either the Salt River Area or for arterial roads in Arizona. The response was that ADOT does collect weight data, but it is focused on freeway operation and that freeway operation is not a representative surrogate for either arterial/local roads or for the Salt River Area.[13] Contacts were also made with a number of aggregate operators located within the Salt River Area to determine if vehicle weight statistics were available to support the development of representative class weights. Despite repeated contacts, no useful data were obtained from this effort.

Failure to identify representative class weights compatible with the collected traffic count data led to a review of guidance on calculating paved road fugitive dust emissions. Guidance with regard to appropriate estimates of vehicle weight is surprisingly limited. The AP-42 documentation[14] indicates that equations used to quantify fugitive dust were based on measurements of vehicles ranging between 2 and 42 tons, but provides no guidance on default values or where to obtain representative estimates. EPA's Emission Inventory

[13] Personal communication between Estomih (Tom) Kombe of AzDOT and Bob Dulla at Sierra Research, October 1, 2007.

[14] *http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0201.pdf*, accessed on November 5, 2007.

Improvement Program contains a Technical Report on Particulate Emissions[15] which states that the fleet average default weight used in the National Emission Inventory (NEI) calculations is 6,360 lbs and "is based on statistics from the early 1990's." This value may not reflect the shift towards sport utility vehicles (SUVs), or the increase in truck traffic produced by NAFTA (North American Free Trade Agreement), so it may underestimate the average weight of vehicles currently operating on the road. A further search of the literature found that the WRAP Fugitive Dust Handbook[16] indicates that the average vehicle weight is assumed to be "2.4 tons in California (except for the SCAQMD that assumes 3 tons)." Several sources[17,18] indicated that 3.0 tons was used for the average weight of vehicles operating on paved roads because the PART5 model provided that as a default value. The ADEQ TSD for the Salt River Area used 3.0 tons to calculate fugitive dust emissions from paved road vehicles.

Based on the available guidance, it appears that the default value currently recommended by EPA is 6,360 lbs. That value, however, is out of date and fails to reflect shifts in vehicle mix that have occurred since the early 1990's. It also does not appear to account for any information on travel from overweight vehicles (i.e., those vehicles which are exceeding allowable axle loads and GVW ratings). The extent of overweight operation is a concern, since these vehicles inflict a disproportionate share of highway pavement damage. A recent study[19] conducted for ADOT entitled "Estimating the Cost of Overweight Vehicle Travel on Arizona Highways" estimated that 30 percent "of in-state travel was comprised of vehicles exceeding legal limits (gross or axle or both)." While that study focused only on heavy-duty vehicles, it provides an Arizona metric of in-use weight that could be used in this analysis. Given the paucity of representative weight data and the fact that current guidance appears to be out of date, the default value referenced in EPA's EIIP guidance was increased by 30 percent. This increase represents a crude estimate of the weight of vehicles operating within the Salt River Area or the U.S. in general. Moreover, it represents over a 1-ton increase in the overall average weight used in the previous Salt River analysis (6,360 x 1.30 = 8,268 lbs or 4.1 tons vs. 3.0 tons). Since the AP-42 paved road travel emission factor equation uses a vehicle weight term raised to the 1.5 power, paved road emission estimates used in this analysis are over 60 percent higher than those used in previous efforts (all other parameters being equal). The point of this exercise is to demonstrate that conservative assumptions were used to estimate paved road emissions.

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[15] *http://www.epa.gov/ttn/chief/eiip/techreport/volume09/pavrd3.pdf*, accessed on November 5, 2007.

[16] *http://www.wrapair.org/forums/dejf/fdh/content/FDHandbook_Rev_06.pdf*, accessed on November 5, 2007.

[17] *http://ndep.nv.gov/baqp/file/pahrump_ei-2001.pdf*, accessed on November 5, 2007.

[18] *http://aqp.engr.ucdavis.edu/Documents/DraftRoadDustreport.pdf*, accessed on November 5, 2007.

[19] *http://www.wilbursmith.com/AT055/Overweight%20vehicles%20in%20Arizona.pdf*

The road segment-average emission factors measured by the SCAMPER system ranged from 0.044 to 0.728 g/mi. For those road segments with an average emission factor of 0.20 g/mi or less, Sierra used the adjusted SCAMPER emission factors to characterize baseline emissions. On these road segments, it was assumed that no trackout occurred. For the road segments with SCAMPER average emission factors greater than 0.20 g/mi, it was assumed that the increase in emission factor above 0.20 g/mi was due to trackout, and a baseline SCAMPER emission factor of 0.20 g/mi was assigned to these segments. For these segments, the excess emission factor was assigned to the trackout emission category, which is discussed in a separate section. As described above, the SCAMPER baseline emission factor of 0.2 g/mi was assumed to be measured on roads with the baseline silt loading of 0.3 g/m^2. At an average vehicle weight of 4.1 tons, this silt loading produced an emission factor of 3.44 g/mi.

4.2 Paved Secondary Roads

Paved secondary roads in the Salt River Area are those local streets and roads that are not arterial roads which are spaced every mile in an east-west, north-south grid. Traffic levels on individual secondary road segments are substantially lower than on almost all arterial roads. As a result, secondary roads contribute much less to area PM-10 emissions and ambient concentrations than arterial roads. For this reason, Sierra computed secondary road emissions in the same manner as for arterial roads, but secondary road emissions were modeled as area sources of uniform distribution over the 400-meter by 400-meter grid cells specified in the Salt River Area TSD.

Activity Rates – Road segment-specific VMT values were computed for secondary roads in a manner similar to that of arterial roads. Traffic counts were recorded on one secondary road segment, Weir Avenue between 35th and 43rd Avenues, in the Salt River Area. The hourly count profile on Weir Avenue was applied to daily traffic counts reported by the MAG travel model to compute hourly traffic levels on each secondary road link in the southern half of the Salt River Area. Because hourly traffic distributions in the northern half of the Salt River Area are more influenced by commercial traffic and less by industrial traffic than the southern half, in the northern half Sierra used the four multihour traffic counts reported by the MAG travel model, as modified by Weir Avenue data, to compute hourly distributions. Link-specific VMT values were assigned to links spatially located by an ArcGIS shapefile provided by MAG. The link-specific data were aggregated by road link to produce total hourly VMT values within individual grid cells in the 30 by 20 cell layer used in the dispersion modeling. As with arterial road volumes, secondary road volumes in 2010 were scaled up from 2005 link-specific values using traffic growth factors provided by MAG.

Emission Factors – Road-specific emission rates were recorded by the SCAMPER system for one secondary road in the Salt River Area. This road segment, on Weir Avenue between 35th and 43rd Avenues, was concluded to be representative of secondary roads in the area on the basis of traffic volume and visible trackout. The SCAMPER recorded an average emission factor of 0.23 grams per mile which converted to a silt loading of

0.362 grams per square meter based on the methodology described in Section 4.1. Because it was concluded that the baseline silt level on roads in the Salt River Area was 0.3 grams per square meter, the trackout silt level on secondary roads was determined to be 0.062 (= 0.362 – 0.300) grams per square meter.

The fugitive PM-10 emission factor for secondary road travel was computed using the AP-42 equation for paved roads. The average vehicle weight was assumed to be 4.1 tons, based on the analysis described in Section 4.1. The baseline silt loading was assumed to be 0.3 grams per square meter on all secondary roads. On the basis of these values, the secondary road baseline emission factor was computed to be 3.88 grams per VMT.

4.3 Arterial Road Trackout

Because the reduction of trackout onto paved arterial roads will result from a different set of control measures than those reducing baseline silt loadings on arterial roads, Sierra evaluated the emissions and impacts of trackout emissions separately. As discussed in Section 4.1, the baseline silt loading on arterial roads in the Salt River Area was assumed to be 0.3 grams per square meter. It was also assumed that any silt loading calculated from SCAMPER measurements in excess of 0.3 grams per square meter was due to trackout activities.

Activity Rates – Since arterial road trackout emissions are generated by the same traffic volumes as arterial road travel, the same road-specific VMT values were used in both analyses. As described in Section 4.1, 2005 VMT estimated were scaled to 2010 values using traffic growth factors provided by MAG.

Emission Factors – Trackout silt loadings on arterial roads varied from 0.00 to 1.34 grams per square meter, as calculated from SCAMPER measurements. The low end of this scale represents road segments that were computed to have total silt loadings of less than 0.3 grams per square meter, indicating silt levels less than the baseline. The upper end of this scale represents road segments frequented by significant traffic flows exiting unpaved parking areas and industrial sites. At this trackout silt loading, the maximum emission factor for trackout emissions was computed to be 9.08 g/mi. For arterial roads on which no SCAMPER runs had been conducted, Sierra assumed that the trackout silt loading was equal to the geometric mean of trackout silt loadings computed from SCAMPER-run arterial roads. This default trackout silt loading was computed to be 0.082 g/m^2. At this default silt loading, the trackout emission factor on unsampled arterial roads in the Salt River Area was computed to be 1.48 g/mi.

4.4 Secondary Road Trackout

Secondary road trackout emissions were generally computed in the same manner as those for arterial road trackout. A uniform trackout silt loading measured at Weir Avenue was used to represent all secondary roads. In the modeling process, however, emissions were uniformly distributed over 400-meter by 400-meter grid cells in the modeling domain instead of being assigned to specific road segment locations.

Activity Rates – The traffic rates that generate emissions from trackout silt loadings on secondary roads are the same as those that generate emissions from baseline silt loadings. As a result, the modeling emission inventory for secondary road trackout used the same activity rates as are discussed in Section 4.2 for secondary road travel.

Emission Factors – From the Weir Avenue SCAMPER measurements, Sierra estimated that the secondary road trackout silt level was 0.062 grams per square meter. At an average vehicle weight of 4.1 tons, the emission factor for this source was computed to be 1.23 g/mi.

4.5 Arterial Road Unpaved Shoulders

During the December 2006 field study in the Salt River Area, blowing dust emissions were observed on unpaved arterial shoulders as a result of truck bow wake passage. Because the City of Phoenix is engaged in an active program to pave or treat unpaved arterial shoulders in the Salt River Area, emissions from this source were computed separately and included the emissions in the modeling analyses.

Activity Rates – Heavy-duty truck counts on arterial roads were determined from the December 2006 traffic counting program. On road segments where counts were conducted, the hourly truck counts were used directly to estimate 2005 truck traffic levels. On road segments that were not counted, the hourly truck traffic profiles were used to disaggregate daily truck VMT from the MAG travel model to hourly values on a link-specific basis.

The locations and extent of unpaved shoulders on arterial roads in the Salt River Area were determined from aerial photographs of the area and observations recorded during an October 2006 site inspection. From these sources, the lengths of shoulders that were unpaved were estimated for each road segment on which traffic counts were collected in December 2006. For arterial road segments on which traffic counts were not taken, it was estimated that 15 percent of shoulders were unpaved from visual analysis of Salt River aerial photographs on the Google Earth website. The shoulder lengths were multiplied by the hourly truck counts to determine hourly bow wake vehicle miles traveled for each road segment. Emissions from this source in 2005 were scaled up to 2010 levels using traffic increase factors provided by MAG.

Emission Factors – Although the literature reports very few truck bow wake emission studies, one good study from the San Joaquin Valley was used to estimate bow wake emissions in the Salt River Area. The San Joaquin Valley study measured wind energy levels and particulate flux away from a paved road on which trucks were traveling at an average speed of 60 miles per hour.[20] The PM_{10} emission factor was computed to be 7.75 grams per vehicle kilometer traveled, or 12.47 g/mi. This emission factor cannot be directly applied to Salt River traffic because of the lower truck speeds on arterial roads found in the Salt River Area. Truck bow wake emissions were assumed in this study to vary with the square of the truck speed, very much as aerodynamic drag, and bow wake energy, vary with the square of vehicle speed. From the MAG travel demand model, Salt River Area truck speed was estimated to average 35 miles per hour. At this speed, the bow wake emission factor was computed to be 4.24 g/mi (= 12.47 g/mi x $\{35 \text{ mph}/60 \text{ mph}\}^2$) at 35 miles per hour.

Sierra also computed windblown PM-10 emissions from unpaved shoulders for modeling purposes. For this calculation, Sierra used the "All Sites" wind erosion equation published in the 1986 Nickling and Gillies study.[21] Because the emission factor predicted by this equation is a function of the wind speed raised to the 4.355 power, it was concluded that the average hourly emission factor based on the average hourly wind speed would be less than the factor based on wind speeds measured during sub-hour increments. Because 5-minute average wind speed data were available from MCAQD for the two monitors during the December 2006 field study period, a statistical analysis of this relationship found the use of 5-minute wind data produced an hourly emission factor that was roughly 10 percent higher than the factor calculated on the basis of the hourly average wind speed. As a result, the statistical model developed from the December 2006 high wind data was used to adjust the Nickling and Gillies equation to account for this phenomenon. The adjusted equation was then used to compute the windblown emission factor for each high wind hour on the February 15, 2006 high wind design day, and these factors were supplied to the AERMOD model input files for modeling on this day.

4.6 Secondary Road Unpaved Shoulders

Unpaved shoulder emissions on secondary roads were computed in the same manner as arterial road shoulder emissions. Because heavy-duty truck counts were much lower on secondary roads, the emissions from unpaved shoulders on secondary roads were much lower than on arterial road unpaved road shoulders. These emissions were modeled as area sources uniformly distributed over the 400-meter x 400-meter grid cells established in the Salt River Area TSD.

Activity Rates – Heavy-duty truck counts on secondary roads were determined from the December 2006 traffic counts on Weir Avenue. The heavy-duty truck fractions of total counts by hour were applied to total traffic volumes on secondary road segments that were

[20] Effectiveness Demonstration of Fugitive Dust Control Measures on Public Unpaved Roads and Unpaved Shoulders on Paved Roads, prepared for the San Joaquin Valley Unified Air Pollution Control District by Desert Research Institute, 1996.

[21] Evaluation of Aerosol Production Potential of Type Surfaces in Arizona, prepared for Engineering-Science by W.G. Nickling and J.A. Gillies, 1986.

computed by the MAG travel model for 2005. The MAG travel model estimates VMT in three vehicle weight classes that are similar to the three axle classes measured in the traffic counts. Because no axle class data on secondary roads were available for the northern portion of the modeling domain, the VMT splits for vehicle classes estimated by the MAG travel model were used to develop hourly heavy-duty truck profiles for all secondary roads in this area. The link-specific VMT values were assigned to links spatially located by an ArcGIS shapefile provided by MAG. The link-specific data were aggregated into hourly VMT values within individual grid cells in the 30 by 20 cell layer used in the dispersion modeling. From aerial photographs of the Salt River Area, it was estimated that 25 percent of secondary road shoulders were unpaved. As with arterial road volumes, secondary road volumes in 2010 were scaled up from 2005 link-specific values using traffic growth factors provided by MAG.

<u>Emission Factors</u> – The truck bow wake and windblown PM-10 emission factors developed for use on arterial road unpaved shoulders were also used to compute emissions from secondary road unpaved shoulders.

4.7 Industrial Stationary Sources

Emissions from industrial stationary, or stack, sources were based on the MCAQD emission inventory.[22] This inventory was adjusted to account for day-specific operating conditions on each of the low wind and high wind design days.

<u>Activity and Emission Rates</u> – Design day-specific activity data were collected from the larger point sources in the Salt River Area through telephone interviews. Point sources are defined in the MCAQD inventory as facilities emitting more than five tons of PM-10 per day. In the telephone interviews, Sierra collected information on which production systems operated during the low wind design days and which hours of each day the systems operated. For facilities emitting less than 0.5 tons per year of PM-10, Sierra assumed daily operations extended from 7:00 am to 5:00 pm. It was assumed that the hourly emission rates for permitted equipment reported in the 2005 inventory would remain unchanged in 2010. Modeling input files for these sources were structured using stack parameters reported in the Salt River Area TSD modeling files or estimated from discussions with facility operators. Stationary source locations were confirmed through use of aerial photographs.

4.8 Industrial Area Sources

Industrial area sources are defined in this study as fugitive PM-10 sources at industrial facilities. These sources include haul road travel, material transfer into and out of haul

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[22] 2005 Periodic Emissions Inventory for PM-10 for the Maricopa County, Arizona, Noinattainment Area, Maricopa County Air Quality Department, May 2007.

trucks, and onsite product delivery truck travel, among others. The MCAQD emission inventory was used as the basis for analysis of emissions from these sources.

Activity Rates – For industrial area source operational emissions, Sierra used the site-specific data provided by MCAQD in Salt River industrial point and area source emission inventory. For these true area sources, such as haul roads and material transfer using mobile equipment, Sierra did not separately identify activity rates from which to compute emissions, but instead used the emissions directly reported by the inventory.

For windblown emissions from industrial disturbed areas, Google Earth aerial photographs were used to identify the boundaries of disturbed areas. Although the photographs of the Salt River Area are two to three years old, observations from an October 2006 field survey indicated that the photographs remain representative of disturbed areas in 2006. From the photographs, Sierra estimated the fractions of disturbed areas within the boundaries of each of the larger industrial facilities impacting either of the two monitors on the two design day periods. These boundaries were supplied to the AERMOD modeling input files as area sources, and windblown emissions fractionally adjusted by disturbed area ratios were assumed to be uniform within the facility boundaries. For a few of the largest facilities, subareas of disturbed soils were separately identified by boundary coordinates and disturbance fractions.

Emission Rates – The MCAQD inventory reports emissions on annual and average annual day bases. From inventory files provided by MCAQD, Sierra computed average hourly operating emission rates for each area source. Design day hours of operation were determined through telephone interviews of facility operators. Modeling files for these sources were constructed to include average hourly emission rates computed from the emission inventory and the specific hours of activity reported by operators for the specific design days. Area source boundaries were identified through the use of aerial photographs.

For windblown emission factors, the hour-specific factors computed by the method described in Section 4.5 were applied.

4.9 Vacant Lots

Vacant lots, as the term is used in this analysis, refers to parcels that are undeveloped or semi-developed and over which vehicle travel and soil disturbance occur. Land uses on these parcels range from large acreage residential to light manufacturing to salvage yards. The bare soil areas on these lots are not used for unpaved parking, which is addressed in Section 4.10. Vehicle trips on these parcels range from one per week to 20 per day. These trips generate emissions both from vehicle travel over unpaved surfaces and from air entrainment of disturbed soils during high wind events. Because activities on these parcels are not required to have permits from MCAQD, emissions from these parcels are regulated by MCAQD Rule 310.01.

Activity Rates – Vehicle travel rates on vacant lots were estimated through visual observation or through engineering judgment based on previous emission inventory work in the Salt River Area. When the initial modeling domains surrounding each of the Durango Complex and W. 43rd Avenue monitors were established, Sierra identified a number of light manufacturing facilities with disturbed unpaved surfaces in close proximity to each monitor. Believing that vehicle trips on these parcels could be a significant source of PM-10 emissions, Sierra retained Applied Environmental Consultants (AEC) of Tempe to conduct visual counts of vehicles moving within and crossing the boundaries of almost 20 partially developed parcels near the two monitoring sites. AEC recorded vehicle counts, vehicle types, and travel distances within each parcel over two hour periods during business hours. Daily hours of activity were estimated from posted business hours or by telephone interview of facility operators.

For windblown fugitive PM-10 emissions, the activity metric is the area of disturbed soil releasing particles into turbulent wind gusts. Sierra used the Google Earth web-based aerial photography platform to identify the boundaries of actively disturbed soil areas within two kilometers upwind of each monitor in the high wind hour directions of February 15, 2006. For both of the monitors, the high wind directions were from the southwest to west quadrant. Although the Google Earth aerial photographs of the Salt River Area are two to three years old, it was assumed from information collected during a field survey in October 2006 that unpaved traveled areas on these sites had not changed in the intervening time.

Emission Factors – Sierra used default soil silt and moisture fractions used in the MCAQD inventory and visually estimated vehicle speeds to compute trip emission factors using the unpaved road AP-42 emission factor equation.[23] For each parcel, the individual trip emissions during each hour of observation were summed together and the hourly average unpaved road travel emissions were computed from the two hourly values. These emissions were distributed uniformly as area sources over the areas identified as disturbed in the Google Earth photographs. These hourly average emissions were also distributed over the hours of business activity at each parcel under the assumption that the activities observed were typical of activity rates throughout the day. To compute windblown PM-10 emission factors for theses parcels, Sierra used the method described in Section 4.5.

Uncontrolled emissions from vehicle movement and wind entrainment of disturbed soils on vacant lots were reduced by a control factor to account for the benefits of Rule 310.01 enforcement in the baseline period. The control factor was calculated as the product of the rule effectiveness quotient and the compliance rate. The rule effectiveness quotient was published in the MCAQD's 2005 rule effectiveness study as 68% for Rule 310.01.[24]

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[23] Compilation of Air Pollutant Emission Factors, Volume 1, AP-42, Fifth Edition (Section 13.2.2, 11/06), U.S. Environmental Protection Agency, January 1995.

[24] 2005 Periodic Emissions Inventory for PM_{10} for the Maricopa County, Arizona, Nonattainment Area, Appendix 2.2 Rule Effectiveness Study for Maricopa County Rules 310, 310.01, and 316, Maricopa County Air Quality Department, May 2007.

The compliance rate of 88.6% was derived from the control efficiency used in the 1999 Serious Area PM-10 Plan.[25]

4.10 Unpaved Parking Lots

Emissions from unpaved parking lot vehicle movements were derived from the Salt River Area TSD modeling files. No changes were made to these files, and they were used for both the low wind and high wind design day modeling analyses. Emissions of windblown PM-10 from unpaved parking lots were calculated in the same manner as those of vacant lots as described in Section 4.9. The boundaries of unpaved parking lots identified in the Salt River Area TSD were determined through use of Google Earth aerial photographs.

4.11 Local Truck Yard

During the October 2006 initial field survey of sources near the two Salt River monitors, Sierra identified a truck yard with unusually high onsite activity very close to the Durango Complex monitor. In the initial modeling of near source impacts, the truck yard produced substantial impacts when winds were blowing from the yard toward the monitor. As a result of these high impacts, effort was devoted to separately quantifying activity rates from this yard in order to develop an accurate emission inventory for this parcel.

<u>Activity Rates</u> – Upon initial contact with the truck yard operators, Sierra learned that the yard was used predominantly as a practice yard for a truck driving school. The surface of the yard consisted of decomposed asphalt concrete mixed with gravel and soil. At one time the yard had been paved, but the traversing of the yard by heavy-duty truck and trailer combinations almost continuously during business hours had caused the complete breakup of the asphalt concrete. Fugitive PM-10 was generated by truck and trailer combinations being driven at slow speeds in circular patterns over the yard by novice trainees for eight hours per day. An average of eight truck and trailer combinations were driven continuously during driver training on the yard in this mode. In addition, 10 truck and trailer combinations were driven offsite in the morning and onsite in the late afternoon by more experienced trainees gaining on-road experience. Infrequently, trailers were either delivered to the yard for storage or picked up for removal. Based on this information and more provided by the facility operator, hourly PM-10 emission rates were computed for this facility on business days. This facility was closed on Mondays, and experienced reduced activity on holiday weeks.

For the computation of windblown emissions, it was assumed on the basis of observation that the yard was completed disturbed.

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[25]Telephone communication between Bob Dulla, Sierra Research, and Cathy Arthur, Maricopa Association of Governments, December 10, 2007.

Emission Factors – Emission factors for the truck yard sources were calculated using a revised version of the unpaved road emission factor published in AP-42. Section 13.2.2 of AP-42 (Unpaved Roads) contains an emission factor equation (#1a) for vehicles traveling on unpaved surfaces at an industrial site that was deemed most appropriate for conditions existent at the truck yard. This equation uses silt content and vehicle weight as the sole independent variables. A warning in this section stated that equation 1a overpredicts emissions for very slow speeds. In order to compensate for this deficiency, Sierra added to the equation a speed correction factor that is contained in equation 1b. This latter equation is recommended for use with publicly accessible roads, dominated by light-duty vehicles. The resulting equation that was used is:

$$E = (k)(s/12)^a(W/3)^b(S/30)^d$$

where: E = particle size-specific emission factor, lb/VMT
k = baseline emission constant, lb/VMT
= 1.5 for industrial roads
s = surface material silt content, %
= 11.9% as specified by MAG
W = mean vehicle weight, tons
= 15 tons for empty truck and trailer combinations
S = mean vehicle speed, mph
= 2.5 mph for all onsite activity
a = 0.9
b = 0.45
d = 0.5

The resulting emission factor produced by this equation was 0.89 lb/VMT. Because the truck yard was partially covered by decomposed asphalt concrete and gravel, it was assumed that emissions were reduced by 50 percent by the presence of these materials.

Windblown emission factors for this yard were derived from the Nickling and Gillies equation for "all sites," using the gusting wind speed adjustment described in Section 4.5.

4.12 Construction Activities

Because the locations of construction activities and emissions move within the modeling domain from year to year, separate estimates of construction emissions were prepared for December 2005, December 2006 and February 2006.

Activity Rates – The methodology used to estimate construction emissions was consistent with the approach MCAQD used to prepare the 2005 Periodic Emissions Inventory for PM-10 for the nonattainment area. In response to a request, the County provided a list of earthmoving permits for locations in the Salt River Area for the period between December 2004 through December 2006, inclusive. The following information was available for each permit:

- Issue Date
- Site ID #
- Permit ID #
- Site Location #
- Parcel #
- Street Address
- Cross Streets
- Project Type
- Project Start Date
- Acreage
- Owner Name

While the information provided on each permit was extensive, not all fields were complete. For example, street number and street name were not always provided. On the other hand, project type, acreage, project start date and cross streets were almost always provided. Also included was information on the assumed duration of construction for different earthmoving project types and related emission factors that the County used to develop the 2005 PM-10 emission inventory.

A set of assumptions was used to determine which projects should be included in an inventory of construction sources for each of the dates noted above, as follows:

- *Acreage* – no permits were included unless the area of disturbance was equal to or greater than an acre.

- *Dates* – the County estimates of project duration (e.g., road construction – 12 months, residential single family – 6 months, commercial – 11 months, etc.) were used to count backwards from the design date and determine if a permitted site would have been active on the design day. Thus, for example, any road construction project started more than 11 months prior to the day to be modeled was excluded from the inventory of sources that impacted that date.

- *Locations* – as noted earlier, a separate approach was used to select permits impacting monitors in December 2006 versus the low wind design dates in December 2005 and high wind date in February 2006. The approach used for December 2006 was only to select permits that were located within 2 miles of either of the Durango or West 43rd monitoring sites (locations marginally over that distance were also included). The distance was based on a screening analysis which indicated that emissions from major roads located more than 2 miles from either monitor had less than 1 $\mu g/m^3$ impact at either monitor. The approach used to select permits for the December 2005 and February 2006 dates was to include all permits with locations that fell within the modeling domain boundaries (i.e., Van Buren to Baseline and 7th Street to 59th Ave).

The impact of the above assumptions on the number of permits and acreage selected for the inventory is displayed below in Table V-4-1. It shows that the use of different location assumptions significantly impacted the number of permits and acres of disturbed earth included in the inventory.

Table V-4-1
Impact of Location Assumption
On Permits and Acreage Included in the Construction Emissions Inventory

Date	Location Criteria	Permits	Acreage
December, 2005	2 miles	36	684.6
December, 2005	Salt River Area	57	905.8
February, 2006	2 miles	51	966.3
February, 2006	Salt River Area	72	1,226.6
December, 2006	2 miles	42	661.3

Emission Factors – The methodology used by the County to estimate the 2005 Emission Inventory was used to estimate emissions for permits determined to be impacting monitors. Emissions for each permit were calculated by multiplying the number of acres times an emission factor that varies by project type (in units of tons/acre-month) times the number of months of construction duration, which also varied by project type. The tons were converted to pounds and divided by the number of months times the weeks per month times a construction schedule that is assumed to run 6 days per week, 10 hours per day. The result was pounds of emissions per working hour per day, which was assumed to run from 7:00 am to 5:00 pm during the inter months. The estimates of uncontrolled emissions were then adjusted for control efficiency and rule compliance (90 percent and 51 percent respectively, which were used by the County in the preparation of the 2005 emissions inventory) to estimate the controlled emissions.

4.13 Agricultural Operations

Two fundamentally different estimates of agricultural emissions were employed in this study. The first was based on the inventory prepared for the Salt River Area TSD. That effort used satellite image analysis of the study area to identify the location of agricultural fields. Tillage emission factors were computed using a methodology established in a

Technical Support Document for Best Management Practices[26] that computed fugitive dust emissions as a function of silt content of the soil (s) and a particle size multiplier (k) where lbs/acre pass = $k(4.8)s^{0.6}$. The key challenge in estimating emissions then became determining the number of acre passes that occur on a specific design day. In the Salt River Area TSD this was calculated by identifying the crop in place on the design day, the number of acre passes required for that crop and the fraction of tillage activity that occurred on the design day. An example helps to illustrate how emissions were estimated for cotton.

Using a silt value of 35.2 percent for land in the modeling domain and a particle size multiplier of 0.15 for PM-10, an emission factor of 6.10 lbs/acre pass was estimated ($0.15 \times 4.8 \times 35.2^{0.6}$) for cotton. A total of 7 separate tillage passes are required for a cotton crop (e.g., laser level, rip, disk, etc.). Analysis indicated that there were 10 acres of cotton fields per grid cell in the modeling domain. The fraction of annual tillage assumed to occur on the design day was estimated to be 0.01. This produced an estimate of 4.27 lbs of PM-10 being emitted from those 10 acres on the design day (i.e., 6.10 lbs of PM-10 per acre pass x 7 passes x 10 acres x 0.01). This estimate did not take into account reductions for agricultural best management practices, which would further reduce the estimate of emissions by 7.9 percent (the midpoint of control efficiency for combining tractor operations).

The key uncertainty in this emissions calculation is the estimate of activity that occurred on the design day. Since field operations data are extremely difficult to obtain, the approach used to estimate activity necessarily assumes that tilling operations can occur on any of the days during a crop's lifespan. This has the effect of producing an estimate of activity that, while statistically correct, significantly underestimates the level of activity on days when the activity occurs (i.e., since on many days, no activity occurs). Thus, Sierra believes the estimates developed using this methodology have the potential to significantly underestimate agricultural emissions when tilling occurs.

This insight was confirmed in discussions with the Arizona Farm Bureau, which confirmed that during the December 2006 days with high concentrations, agricultural activities in the Salt River Area were continuous (i.e., 24-hours/day) as farmers were in the process of converting fields from cotton to wheat. During this time, 4 separate tilling operations were performed, including: discing, ripping, land planing and forming. Using this information and related estimates of tractor speed and implement width, a significantly higher estimate of emissions was prepared for those days.

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[26] Technical Support Document for Quantification of Agricultural Best Management Practices, Final, Prepared for Arizona Department of Environmental Quality by URS Corporation and Eastern Research Group, June 2001.

Activity Rates and Emission Factors – The approach used to estimate emissions in December 2006 was to use tilling activity-specific emission factors from CARB[27] for Agricultural Land Preparation. Those values are summarized in Table V-4-2 below.

A web search produced an average tractor plow down speed of 2.2 mph[28] for corn, which the Arizona Farm Bureau confirmed as reasonable for the operations being performed in December. Using a disc implement width of 10 feet, it was calculated that 2.7 acres could be tilled each hour. When combined with the average emission rate of 4.8 lbs of PM-10 per acre pass, this produced an estimate of 12.95 lbs of PM-10 being emitted per hour of tilling activity. That value was then used to compute the level of PM-10 emitted within each 400-meter by 400-meter grid cell. The time required to till an entire grid cell was estimated to be 14.58 hours (39.54 acres/grid cell/2.7 acres/hour). The total level of PM-10 emitted within a grid cell within a 24-hour period was estimated to be 12.95 lbs of PM-10 per hour x 14.58 hours or 188.80 lbs of PM-10 emitted per day. Since the time at which the tilling occurred is unknown, that estimate was distributed across a 24-hour period to produce an estimate of 7.87 lbs of PM-10 emitted per hour per grid cell. These emission estimates were applied to the grid cells determined to have agricultural land in the Salt River Area TSD to prepare an estimate of agricultural emissions in 2006. As discussed in Section 3, the use of these estimates helped produce stronger model performance (based on a comparison between hourly concentration estimates and monitored values across all sources).

To contrast the emission estimates produced by this method with those developed in the Salt River Area TSD, it is necessary to place them on a common basis. The TSD produced an estimate of corn tillage of 4.27 lbs of PM-10 over a 10-acre parcel on the design day or 0.427 lbs/acre. The above method estimated an average emission rate of 4.8 lbs/acre. The difference is an order of magnitude.

Unfortunately, no information was available to quantify agricultural activity in December 2005. Initially, it was assumed that the activity levels computed for December 2006 should be applied to December 2005. However, modeling analysis indicated this assumption produced unacceptable overestimates of hourly average concentrations relative to measured concentrations (across all sources). For this reason, the values calculated for the Salt River Area TSD were used to represent baseline agricultural emissions in December 2005 and February 2006.

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[27] *http://www.arb.ca.gov/ei/areasrc/fullpdf/full7-4.pdf*

[28] *http://asae.frymulti.com/abstract.asp?aid=8367&t=2*

Table V-4-2 Land Preparation Emission Factors Used to Prepare December 2006 Agricultural Estimate of Agricultural Fugitive Dust Emissions	
Land Preparation Operation	Emission Factor (lbs/acre pass)
Discing, Tilling, Chiseling	1.2
Ripping, Subsoiling	4.6
Land Planing & Floating	12.5
Forming/Planting*	0.8
Average	4.8
* Discussions with CARB staff indicated that the weeding emission factor would be appropriate for this activity.	

4.14 Alluvial Soils

Alluvial soils are the finely graded surface soils in the Salt River channel that are deposited as silt layers during high water events. Because these soils consist of unconsolidated mixtures of fine silts and clays, wind entrainment of uncrusted deposits from these surfaces results in significant emission rates. In the ADEQ TSD, areas of surface alluvial soils were mapped and identified with respect to minimum, moderate, and maximum windblown emission potential. Separate baseline emission rates were assigned to represent each of the three soil types. A similar methodology was used in this analysis, using the ADEQ map of soil types and emission rates defined in the wind tunnel measurements conducted in the 1986 Nickling and Gillies study for each of those soil types..

In 2004 and 2005, the City of Phoenix undertook substantial effort to curtail trespass onto alluvial soils between 35th and 51st Avenues by both erecting barriers and citing trespassers. Citation statistics between 2004 and 2005 indicate a substantial reduction in trespass activity onto these lands. In the ADEQ TSD, these measures -at that time only proposed - were estimated to reduce emissions by 72%. In the absence of any other data, this reduction fraction was used to adjust baseline emissions in this category from the ADEQ TSD values.

4.15 Summary

A tabulation of the PM-10 emission inventory contributions generated by each of the previously described source categories in the Salt River Area is presented below in Table V-4-3. While separate values are listed for the low and high wind design days, a review of the entries shows that most are the same and the only notable differences are for construction activities and the local truck yard. Paved road related emissions represent the dominant source category accounting for over 65 percent of the inventory under both low and high wind conditions. It should be noted, however, that many sources contribute to trackout and that the distribution of sources displayed in the table does not account for each source's sole contribution to the inventory. No values for windblown emissions are displayed. This is because they are calculated internally by AERMOD using input parameters (e.g., wind speed and wind speed-specific emission factors) and are not provided in model outputs.

Table V-4-3 **Summary of Source Specific PM-10 Emissions for Salt River Area Modeling Domain And Design Day Conditions (tons/day)**		
Source Category	Low Wind	High Wind
Freeway Traffic	0.55	0.55
Arterial Traffic	5.05	5.05
Secondary Traffic	2.21	2.21
Arterial Trackout	2.17	2.17
Secondary Trackout	0.79	0.79
Arterial Shoulders	0.08	0.08
Secondary Shoulders	0.03	0.03
Industrial Area	2.70	2.70
Industrial Point	0.60	0.60
Vacant Lots	0.05	0.05
Unpaved Parking Lots	0.04	0.04
Agricultural Operations	0.10	0.10
Construction Activities	1.98	2.20
Local Truck Yard	0.00	0.01
Total	16.35	16.59

5. AIR QUALITY MODELING

5.1 Model Selection

In the PM-10 modeling protocol document,[29] MAG determined that grid-based dispersion modeling represents the best option for evaluating source contributions impacting the Salt River monitors. Several factors contributed to this decision, including the following:

- Complexity of meteorology and terrain in the Salt River;
- Diversity of sources located within the Salt River;
- A PM-10 Source Attribution and Deposition Study funded by MAG in 2006 to quantify the impact of sources located within the Salt River Area; and
- Previous work by ADEQ characterizing many of the parameters needed to perform dispersion modeling within the Salt River Area.

Based on a review of EPA guidelines, it was also determined that AERMOD was the most suitable dispersion model for evaluating hourly source contributions to PM-10 exceedances recorded at the Salt River monitors (i.e., Durango Complex and West 43rd Ave.). AERMOD (AMS/EPA Regulatory Model) is a steady-state Gaussian plume dispersion model that assesses pollutant concentrations from a variety of sources. Sources and receptors located in complex terrain can be simulated considering the transport and dispersion from multiple point, area and/or volume sources based on characterization of the boundary layer. Mobile sources are considered as multiple area or volume sources joined together.

EPA adopted AERMOD as a regulatory model on December 9, 2005, as a replacement for ISCST3 (i.e., the model employed in the previous ADEQ analysis). Compared with ISCST3, AERMOD contains improved algorithms for dealing with low wind speed (near calm) conditions. As a result, AERMOD can produce model estimates for conditions when the wind speed is less that 1 m/sec.[30], [31] This feature is of particular interest for stagnant conditions that characterize the low wind design period of December 11-13, 2005. Another consideration in the selection of AERMOD is that no other model was found to perform

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[29] Modeling Protocol in Support of a Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area, Final, Maricopa Association of Governments, September 29, 2006

[30] Revisions to the Guideline on Air Quality Models: Adoption of Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions, U.S. Environmental Protection Agency, Federal Register, Vol. 70, No. 216, p. 68218, Novemenber 9, 2005 (Attachment IV)

[31] User's Guide for AERMET, EPA-454/B-03-002, November 2004

better for modeling area source fugitive dust. This is important because fugitive dust is a major contributor to high PM-10 levels in the Salt River Study Area and throughout the remaining nonattainment area.[32]

Other characteristics supporting the selection of AERMOD for application in the Salt River Study Area include the following:

- A wide range of regulatory applications can be handled in all types of terrain;

- Gravitational settling and dry deposition are handled well when fugitive dust emissions are properly specified;

- Low-level emission sources, such as area sources, can be modified to produce a more realistic urban dispersion; and

- The minimum layer depth can be changed to calculate the effective parameters for all dispersion settings.

Despite its advantages for PM-10 modeling, AERMOD was also determined to have some shortcomings:

- Urban transport of PM-10 is not addressed;
- Secondary PM-10 formation is not addressed;
- Source-receptor locations need to be well defined; and
- Representation of the modeling domain can be data-intensive (e.g., microinventories, meteorology).

As discussed below, none of theses concerns were determined to severely limit model performance in the Salt River Area.

- *Urban Transport* – An analysis of monitors located outside and upwind of the modeling domain was performed to quantify background values for use in representing urban transport separately under low wind and high wind conditions.

- *Secondary PM-10 Formation* – While fugitive dust is the dominant source of emissions impacting monitors within the Salt River Area, other sources contributing to PM-10 concentrations include directly emitted PM-10 (e.g., Diesel soot, etc.) and secondary particulate (i.e., particles formed through atmospheric chemical reactions from precursor gases, primarily oxides of nitrogen, oxides of sulfur and ammonia). This analysis quantified fugitive dust and PM-10 directly emitted within the Salt River Area. Given the limitations of AERMOD and the fact that secondary particulate is

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[32] 2002 Periodic Emissions Inventory for PM-10 for the Salt River Area, Technical Support Document, Air Quality Division, Arizona Department of Environmental Quality, June 2005

produced throughout the nonattainment area, it will be addressed as a component of background.

- *Source Receptor Locations* – Data collected in the Source Attribution and Deposition Study were used to identify significant sources within the modeling domain. Effort was focused on collecting activity data specific to the design days where possible to improve the representation of source emissions in the modeling inventory. Receptors were located at the three monitoring sites located within the modeling domain, which exceeded the standard, so that predicted values could be contrasted with monitored values under low and high wind conditions.

- *Representation of the Modeling Domain* – As noted earlier, the previous ADEQ modeling analysis characterized many of the parameters needed to represent the modeling domain. In addition, the Source Attribution and Deposition Study provided extensive information on activity within the modeling domain. In light of these considerations, this issue was determined not to be a concern.

5.2 Source Configuration

As noted in Section 1.2, this analysis employed the same modeling domain and grid cell structure used in the Salt River Area TSD (i.e., 400 x 400 meter grids, 30 in the east-west direction and 21 in the north-south direction). The TSD treated most sources as area sources and distributed their emissions evenly throughout the grid. This study, however, employed a different approach to characterize source emissions within the modeling domain. This reflects the concern that distributing emissions from sources uniformly over a grid cell diminishes the ability of the model to correctly resolve source-specific impacts at receptors, because the source boundaries are enlarged and the emission density is diminished. For example, the geographical distribution of street sources disappears when distributed within grid cells, and emissions from significant streets within the same grid cell can impact the monitor independent of the wind direction. Presented below is a brief review of the approach used in this study to characterize each source category.

- *On-road* – There are three on-road related sources: traffic, trackout, and unpaved shoulders. For freeways and primary roads, all three sources are represented by volume sources—each road segment was treated as a set of volume sources in dispersion modeling analysis. The volume source release heights and vertical dispersion parameters ($ó_z$) were taken from the CALINE-4 manual[33] formula 5-12 ($ó_z$ = 4.0/2.15 =1.86). The lateral dispersion parameter ($ó_y$) was set to L/2.15 meters, where L = (n*12+20)*0.3048 meters (length of volume source used to represent a piece of the freeway segment or the distance between separated

[33] CALINE4 – A Dispersion Model for Predicting Air Pollutant Concentrations Near Road Ways, California Department of Transportation, June 1989 Update.

volume sources used to represent the freeway segment, where n is the number of lanes on the segment of the road). The UTM coordinates for relevant freeways and freeway segments were identified and combined with the other dispersion parameters to prepare the AERMOD input files. The emissions of traffic, trackout, and unpaved shoulders from each road segment were divided among the total number of volume sources in that segment. The diurnal variation of the road emissions was calculated based on traffic count data collected in the Salt River Area in December 2006. For secondary roads, the emissions (traffic, trackout, and unpaved shoulders) are allocated to grid cell area sources with dimensions of 400 meter by 400 meter. The emission rates and emission diurnal variation for all these road sources were calculated based on the corresponding traffic count data coupled with emission factors.

- *Industrial* – Facilities located in the Salt River PM-10 modeling area were identified through MCESD permit records and GIS analysis was used to determine if a source was located in the study area. Sources with total annual emission rates that are equal to or greater than 0.5 tons of PM-10/year were included in the model. Emissions from stacks were modeled using parameters extracted from the Salt River Area TSD, which are based on the Maricopa County emission survey forms. For those stacks not included in previous Salt River TSD, the parameters were derived from the MCESD permit records industry process descriptions. All other industrial emissions were modeled as area sources. In the previous Salt River TSD, these sources were treated as two different categories: 36 larger facilities using their geographic locations and 45 smaller facilities using grid area sources. In this study, the area sources within each industrial facility were modeled using their geographic locations based on MCESD permit records. Haul road transport emissions from two facilities were represented by a set of volume sources along the haul road. In summary, the 65 industrial facilities located within the Salt River Area were represented as 58 area sources, 46 point sources, and 353 volume sources.

- *Vacant Lots* – Several additional parking lots were identified and added in the model as area sources using their geographic locations. The emission rates were estimated based on the Salt River Area field work conducted in November/December 2006. The emissions are distributed to the area defined by the boundaries observed in satellite images from Google Earth.

- *Local Truck Yard* – A local truck yard in close proximity to the Durango Complex was also added as an area source to the model based on the November/December 2006 field study. The boundaries were determined from inspecting satellite images on Google Earth. The emission rates from this source were estimated based on the truck activity data obtained from a phone interview with the facility operator and silt loading data from the field study. The emissions were evenly distributed within the boundaries of the facility.

- *Unpaved Parking Lots* – The modeling parameters from the Salt River Area TSD modeling files[1] were used to represent this source category. The emissions were uniformly distributed within the grid cell in which the lot was located.

- *Agricultural Operations* – The modeling parameters, including area size and operating hours from Salt River Area TSD modeling files,[34] were used to represent this source category. The emission rates from 2002 were reduced by the 4.6 percent annualized attrition rate detailed in the Emission Inventory Section to produce the 2005 inventory. The emissions were uniformly distributed within the grid cell in which each parcel is located.

- *Construction* – The residential and road construction emissions in the Salt River Area were based on MCESD permit records. The information in these records was combined with emission factory and activity assumptions employed in the County's 2005 Emission Inventory Report to generate emission estimates for each site. Emissions from each site were represented as area sources in AERMOD using the geographic locations and sizes extracted from MCESD permit records. To exclude those sources that have negligible impacts, only the construction areas that were at least one acre (equivalent to 8.8 lbs of PM-10/day) were included in the model. As described in the Emission Inventory Section, separate inventories were prepared for the low and high wind design days. Thus, a total of 57 construction sources were included in the low wind design episode modeling input files, and 55 were included for the high wind design day modeling input files.

- *High Wind* – Seven separate categories of windblown dust were estimated for the high wind day: industry, vacant lots, unpaved parking lots, unpaved shoulders, construction, agriculture, and alluvial. The standard emission factor approach was taken, in which a certain mass flux was computed for each hour with wind exceeding the resuspension velocity. Visual inspection of Google Earth images was used to define the percent of area for each parcel that was disturbed. For agriculture, alluvial and unpaved parking lots, the emissions were distributed throughout the grid cells in which they were located. Other sources were configured with actual physical boundaries to locate the area over which the emissions are distributed.

As discussed in the Inventory Development section, considerable effort was devoted to the preparation of representative source-specific emission estimates. Where day-specific activity data were available, emission estimates were configured to specific days. In other cases, activity estimates were available to characterize emissions for the time of year (e.g., construction). In still other cases, the emission estimates were the same for all of the days addressed under both low and high wind conditions (e.g., travel related). As will be

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[34] Revised PM-10 State Implementation Plan for the Salt River Area ISCST model files obtained from Air Quality Division Arizona Department Of Environmental Quality, September, 2005.

discussed in a subsequent section, separate background PM-10 concentration estimates were prepared for the low and high wind days. A summary of differences in the emission estimates by design day is presented in Table V-5-1.

As can be seen, there is considerable variation in the day-specific emission estimates for many of the sources. For paved road and related categories of emissions, the weekday VMT estimates for the Salt River Area were adjusted by the ratio of weekday to weekend traffic to produce an estimate of weekend traffic and emissions. The same weekday estimates were used to represent vehicular emissions for each of the remaining low and high wind days (i.e., no distinction was made between traffic levels in December 2005 and February 2006). Information on day-specific hours of operation for different categories of activity was obtained from the larger facilities within the Salt River Area. This information was used to prepare day-specific estimates separately for industrial point and area sources in December 2005 for those facilities.[35] Emissions for the remaining facilities were the same for all of the design days, except Sunday when they were assumed not to be operating. Lacking data for the larger facilities on the high wind day, an assumption was made that emissions would be the same as those on the December 12, 2005 design day. Activity and emissions were assumed to be the same for vacant lots, unpaved lots, and agricultural activities for all days. Information from the operator of the local truck yard was used to configure emission estimates for days when activity varied (i.e., Monday was a shutdown day and the week of February 15th was a holiday week and activity levels were lower than normal). No construction activity was assumed to occur on Sunday and separate values were computed for remaining low wind days and high wind day. As will be discussed in a subsequent section, considerable effort was expended in developing separate estimates of background concentrations on low and high wind days.

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[35] Maricopa County provided annual emission estimates for all industrial sources operating within the Salt River Area. Those estimates were provided separately for point and non-point sources. The criteria used to define a point source, however, were based on the level of pollutants emitted by a facility in a year (for PM-10, the threshold is 5 tons). Since both the point and non-point inventories include a mixture of stationary and area processes, the processes and their emissions were reorganized into separate point (i.e., stack) and area source (e.g., haul road, storage pile) emission estimates for use in the modeling analysis.

Table V-5-1
Summary of Source Category Contributions
To Design Day Emission Inventories

Source Category	Low Wind Episode			High Wind Day
	12/11/05 Sunday	12/12/05 Monday	12/13/05 Tuesday	02/15/06 Wednesday
Freeway Traffic	Weekend	Weekday	Weekday	Weekday
Arterial Traffic	Weekend	Weekday	Weekday	Weekday
Secondary Traffic	Weekend	Weekday	Weekday	Weekday
Arterial Trackout	Weekend	Weekday	Weekday	Weekday
Secondary Trackout	Weekend	Weekday	Weekday	Weekday
Arterial Shoulders	Weekend	Weekday	Weekday	Weekday
Secondary Shoulders	Weekend	Weekday	Weekday	Weekday
Industrial Area	-	Day Specific	Day Specific	38697
Industrial Point	-	Day Specific	Day Specific	38697
Vacant Lots	Average Day	Average Day	Average Day	Average Day
Unpaved Parking Lots	Average Day	Average Day	Average Day	Average Day
Local Truck Yard	Normal Schedule	-	Normal Schedule	Holiday
Agricultural Operations	Average Day	Average Day	Average Day	Average Day
Construction Activities	-	Low Wind	Low Wind	High Wind
Windblown Soil	-	-	-	High Wind
Background	Low Wind	Low Wind	Low Wind	High Wind

5.3 Meteorological Data

AERMET, a preprocessor that converts raw meteorological data into an AERMOD-ready format was used to prepare meteorological input files for the Durango Complex and West 43rd monitoring sites for selected design days. The following data sources were used to configure AERMET to produce these files:

- The on-site met data came from West 43rd and Durango met data, with parameters of wind direction, wind speed, and temperature. A wind speed threshold of 0.0 meters/second was specified.

- Upper air met data were derived from Tucson 1996-2006 twice-daily sounding data.

- National Weather Service (NWS) met data (specifically, cloud cover data) came from the Phoenix NWS met station at Sky Harbor Airport.

AERMET also requires information on three site-specific land use parameters: the Bowen ratio (a measure of moisture available for evaporation), the albedo (portion of sunlight that is reflected), and surface roughness length. These parameters are functions of ground cover (land use), and affect the concentration calculations. These values are calculated by season. A summary of the months included in each season is presented below.

Season #	Season	Months
1	Winter	December, January, February
2	Spring	March, April, May
3	Summer	June, July, August
4	Autumn	September, October, November

The season-specific parameters used to represent the Durango Complex and the West 43rd monitoring site are listed in Tables V-5-2 and V-5-3. Values appropriate to the fall season were used to represent the winter season because tabulated winter values assume the presence of snow pack which is not representative of Phoenix. Since no meteorological information specific to the Bethune Elementary School site is available, it was modeled using the meteorological data from the nearest monitoring site, the Durango Complex, which is located roughly 1.6 miles to the southwest.

AERMET output parameters used as meteorological inputs to AERMOD include wind speed, wind direction, temperature, Convective Boundary Height (m), Mechanical Boundary Height (m), Monin-Obukhov Length (m) and Monin-Obukhov Length (m). A summary of the values produced for each design day and monitoring site is presented in Tables V-5-4 through V-5-7.

Table V-5-2 **AERMET Stage 3 Met Processing Parameters** **Durango Complex Monitoring Site**		
Sector Definition		
Sector	Starting Angle (degree)	Ending Angle (degree)
1	90	225
2	225	90

Seasonal Parameters				
Season	Sector	Albedo	Bowen Ratio	Roughness Length (m)
1	1	0.45	5	0.2
1	2	0.45	5	0.6
2	1	0.3	6	0.2
2	2	0.3	6	0.6
3	1	0.28	10	0.2
3	2	0.28	10	0.6
4	1	0.28	10	0.2
4	2	0.28	10	0.6

Table V-5-3 **AERMET Stage 3 Met Processing Parameters** **West 43rd Avenue Monitoring Site**		
Sector Definition		
Sector	Starting Angle (degree)	Ending Angle (degree)
1	90	180
2	180	90

Seasonal Parameters				
Season	Sector	Albedo	Bowen Ratio	Roughness Length (m)
1	1	0.45	5.0	0.40
1	2	0.45	5.0	0.20
2	1	0.30	6.0	0.40
2	2	0.30	6.0	0.20
3	1	0.28	10.0	0.40
3	2	0.28	10.0	0.20
4	1	0.28	10.0	0.40
4	2	0.28	10.0	0.20

Table V-5-4 Meteorological Data File used for December 12, 2005 Modeling at Durango Complex						
Date/Hour	Wind Direction (Degrees)	Wind Speed (m/sec)	Temperature (K)	Convective Boundary Layer Height (m)	Mechanical Boundary Layer Height (m)	Monin-Obukhov Length (m)
05121201	100	0.5	283.2	-999*	9	3.7
05121202	327	0.8	283.2	-999	31	8.8
05121203	313	0.4	282.8	-999	11	4.4
05121204	136	0.4	282.9	-999	7	2.7
05121205	244	0.28	282	-999	7	3.4
05121206	210	0.28	282.2	-999	4	1.8
05121207	171	0.3	282	-999	4	2.2
05121208	103	0.4	282.4	-999	7	2.9
05121209	151	0.4	283.6	-999	7	8.2
05121210	252	0.28	286.4	17	42	-5
05121211	29	0.6	287.9	39	104	-10
05121212	60	1.7	290	70	331	-69.7
05121213	103	1.3	290.8	104	166	-15.4
05121214	239	1.1	290.4	134	203	-27.2
05121215	236	0.8	291.2	156	138	-17.8
05121216	219	0.7	290.8	162	66	-14
05121217	231	0.7	290	-999	26	14.4
05121218	244	0.6	289	-999	20	7.3
05121219	151	0.4	288.4	-999	7	3
05121220	315	0.4	287.9	-999	11	4.8
05121221	84	0.5	287	-999	15	6
05121222	110	0.4	286.9	-999	7	2.9
05121223	291	0.8	285.2	-999	31	8.8
05121224	161	0.4	283.4	-999	7	2.5
05121301	122	0.9	282	-999	23	6
05121302	309	0.3	280.9	-999	7	3.3
05121303	206	0.28	279.9	-999	4	1.6
05121304	175	0.28	278.9	-999	4	1.6
05121305	172	0.28	278.4	-999	4	1.6
05121306	161	0.5	278	-999	9	3.1
05121307	181	0.4	277.5	-999	7	2.7
05121308	187	0.4	277.4	-999	7	2.2
05121309	143	0.5	282	-999	9	8.6
05121310	149	0.8	284.9	188	110	-3.9
05121311	162	0.9	288.4	399	137	-3.3
05121312	250	0.8	291.5	819	196	-5.1
05121313	232	1.1	291.8	929	266	-9.1
05121314	271	1	292	967	211	-12.5
05121315	235	1.3	292.9	1068	264	-25.7
05121316	238	1.2	291.4	1144	216	-37.7
05121317	223	1.1	290.8	-999	68	43.5
05121318	166	0.4	287.5	-999	14	2.5
05121319	216	0.3	286.2	-999	4	1.9
05121320	94	0.6	284.9	-999	12	3.3
05121321	71	0.9	284.2	-999	37	8.2
05121322	16	0.6	283.4	-999	20	6.6
05121323	324	0.5	282	-999	15	5.5
05121324	122	0.4	281.1	-999	7	2.5

Table V-5-5 Meteorological Data File used for December 2005 Design Days Modeling at West 43rd						
Date/Hour *	Wind Direction (Degrees)	Wind Speed (m/sec)	Temperature (K)	Convective Boundary Layer Height (m)	Mechanical Boundary Layer Height (m)	Monin-Obukhov Length (m)
05121201	68	0.6	280.8	-999	12	4.4
05121202	308	0.7	281	-999	16	4.7
05121203	229	0.4	280.1	-999	7	2.7
05121204	194	1.0	280.4	-999	27	6.7
05121205	277	0.8	280	-999	19	5.8
05121206	247	0.4	279.6	-999	7	2.5
05121207	167	0.3	280	-999	5	2.8
05121208	102	0.6	280.9	-999	17	5.9
05121209	212	0.4	282	-999	7	7.2
05121210	48	0.4	283.9	16	37	-4.8
05121211	272	1.0	286	36	114	-12.7
05121212	234	1.1	287.4	65	133	-12
05121213	246	1.6	289.4	98	202	-24.7
05121214	274	1.2	289.8	128	146	-14.3
05121215	279	0.8	290.2	149	91	-8
05121216	230	0.6	289.9	154	55	-10.9
05121217	265	0.7	289.4	-999	16	8.6
05121218	311	0.4	287.4	-999	7	3
05121219	181	0.7	286.2	-999	16	5.2
05121220	336	0.4	285.5	-999	7	2.9
05121221	100	1.1	284.9	-999	41	10.8
05121222	200	0.4	284.4	-999	8	2.9
05121223	292	1.1	282.9	-999	31	7.4
05121224	213	1.0	281.4	-999	27	6.3
05121301	147	0.8	280.2	-999	25	7.2
05121302	270	0.8	279.6	-999	19	5.3
05121303	225	1.0	278	-999	27	5.5
05121304	218	1.0	277.2	-999	27	5.5
05121305	202	0.3	276.4	-999	5	1.6
05121306	214	0.8	276	-999	19	5
05121307	222	0.6	275.5	-999	12	4
05121308	229	0.6	275.9	-999	12	3.3
05121309	178	0.7	278.4	-999	21	14
05121310	165	0.7	281.9	181	123	-5.1
05121311	211	0.8	285.9	389	123	-2.7
05121312	267	1.0	289.9	814	159	-3.4
05121313	243	1.0	291	926	160	-3.3
05121314	635	1.5	290.4	962	210	-12.5
05121315	312	2.6	290.4	1020	374	-53.8
05121316	281	1.2	290.9	1110	153	-16.5
05121317	245	0.8	289.9	-999	39	10.6
05121318	152	0.8	286.9	-999	25	6.8
05121319	126	0.4	284.5	-999	9	3.4
05121320	122	0.9	282.4	-999	30	6.7
05121321	89	1.4	281.4	-999	44	7.7
05121322	50	1.4	281.4	-999	44	9.4
05121323	253	0.6	280.2	-999	13	4
05121324	105	0.5	279.1	-999	13	4.2

Table V-5-6 Meteorological Data File Used For February 15, 2006 Modeling at Durango Complex						
Date/Hour	Wind Direction (Degrees)	Wind Speed (m/sec)	Temperature (K)	Convective Boundary Layer Height (m)	Mechanical Boundary Layer Height (m)	Monin-Obukhov Length (m)
06021501	43	1.52	286.4	-999	167	13
06021502	52	1.61	285.5	-999	90	13.7
06021503	65	0.4	284.1	-999	19	3.4
06021504	117	0.58	282.3	-999	12	3
06021505	31	0.58	281.9	-999	19	4.9
06021506	101	0.58	281.3	-999	12	3
06021507	86	1.03	281.6	-999	46	8.9
06021508	67	1.34	285	-999	68	11.6
06021509	74	1.43	290.9	11	228	-221.6
06021510	226	0.67	294.5	478	155	-4.7
06021511	259	1.79	295	754	439	-22.4
06021512	270	1.52	295.9	843	344	-22.7
06021513	264	0.9	296.5	1046	236	-5.1
06021514	279	1.58	297.5	1103	402	-14.8
06021515	220	4.33	298.4	1153	787	-65.5
06021516	239	6.3	299.1	1189	2011	-594.5
06021517	247	6.93	298.9	1316	2269	-1605.2
06021518	260	6.75	297.1	-999	2142	2105.2
06021519	263	5.95	294.7	-999	1757	800.1
06021520	272	6.26	292.8	-999	1874	941
06021521	271	3.26	291.4	-999	870	148
06021522	254	2.24	290	-999	344	44.6
06021523	230	2.86	289.4	-999	470	103.3
06021524	230	2.95	289.2	-999	501	112.5

Table V-5-7 Meteorological Data File Used For February 15, 2005 Modeling at West 43rd						
Date/Hour	Wind Direction (Degrees)	Wind Speed (m/sec)	Temperature (K)	Convective Boundary Layer Height (m)	Mechanical Boundary Layer Height (m)	Monin-Obukhov Length (m)
06021501	59	1.79	283.9	-999	148	9.3
06021502	59	1.34	283.3	-999	45	6.9
06021503	165	0.28	281.3	-999	8	2
06021504	163	0.28	279	-999	5	1.9
06021505	79	0.58	278.6	-999	12	3
06021506	157	0.98	278.5	-999	35	6.7
06021507	135	0.8	278.3	-999	25	5.6
06021508	184	0.28	279.9	-999	4	1.5
06021509	287	1.43	283.6	-999	128	2427.4
06021510	276	2.06	287.6	450	307	-19.7
06021511	286	2.32	291	736	378	-16.9
06021512	293	1.43	293.4	824	214	-8.8
06021513	287	0.89	294	1030	153	-2.2
06021514	302	1.56	295.6	1096	262	-6.3
06021515	243	4.29	297.5	1146	778	-64.2
06021516	239	6.93	297.9	1182	1432	-304.2
06021517	246	6.53	297.4	1256	1293	-527.9
06021518	255	6.75	295.5	-999	1294	1001.7
06021519	257	6.44	292.6	-999	1174	384.8
06021520	277	5.68	290.5	-999	962	291.1
06021521	275	2.55	289.1	-999	382	26.6
06021522	242	1.39	287.9	-999	132	7.4
06021523	226	3.93	287.9	-999	497	110.8
06021524	224	3.71	287.5	-999	445	95.4

Due to the size of the tables, the footnotes for the column headings are listed below:

- Date/Hour: Year, month, hour, minute (e.g., 05121201 is 12:01 a.m. on December 12, 2005).
- Convective Boundary Layer Height: -999 indicates missing data in the convective boundary height.

Wind speed, wind direction, and temperature all play important roles in air dispersion. Additional parameters produced by AERMET that also influence dispersion include convective boundary height[36] and mechanical boundary height, which are used to determine planetary boundary layer (PBL) height. PBL height is a term to describe the elevation level up to which vertical mixing of ground-based emissions takes place. A low PBL height indicates weak dispersion and the potential for pollutant concentrations to remain high. AERMET estimates the height of the PBL during convective conditions as the maximum of the estimated (or measured if available) convective boundary layer height (z_{ic}) and the estimated (or measured if available) mechanical mixing height (z_{im}). In early morning hours, or overnight when the atmosphere is stable, there is little or no convective mixing, and so the height of the PBL would be determined mainly by mechanical mixing. Therefore, AERMET sets the height of the boundary layer to the boundary layer is the greater of the mechanical and convective mixing heights. The Monin-Obukhov length (L) is used as the stability parameter, and is computed by the AERMET meteorological preprocessor. It is negative during the day when surface heating results in an unstable atmosphere and positive at night when the surface cools (stable atmosphere). Values near zero during the day time (negative) indicate very stable conditions, while values near zero during the night time (positive) indicate very unstable conditions.

It should be noted that no data are presented for December 11, 2005. That is because upper air data from Tucson were not available for that date and were missing for the period between December 1 and December 11. Lacking this information, AERMET could not provide an estimate of the convective layer height for the mid-day period. In light of this limitation and the fact that the 24-hour PM-10 standard was not exceeded on that date, MAG made a decision to not perform modeling for that day. A summary of the days modeled for each monitoring site is provided in Table V-5-8.

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[36] The convective boundary height is mainly driven by solar energy and that is why it is missing during night time and early morning.

Table V-5-8 Summary of Days Modeled for Each Monitoring Site				
Monitoring Site	Low Wind Days			High Wind Day
	12/11/05	12/12/05	12/13/06	02/15/06
Bethune Elementary	No	Yes	No	No
Durango Complex	No	Yes	Yes	Yes
West 43rd Avenue	No	Yes	Yes	Yes

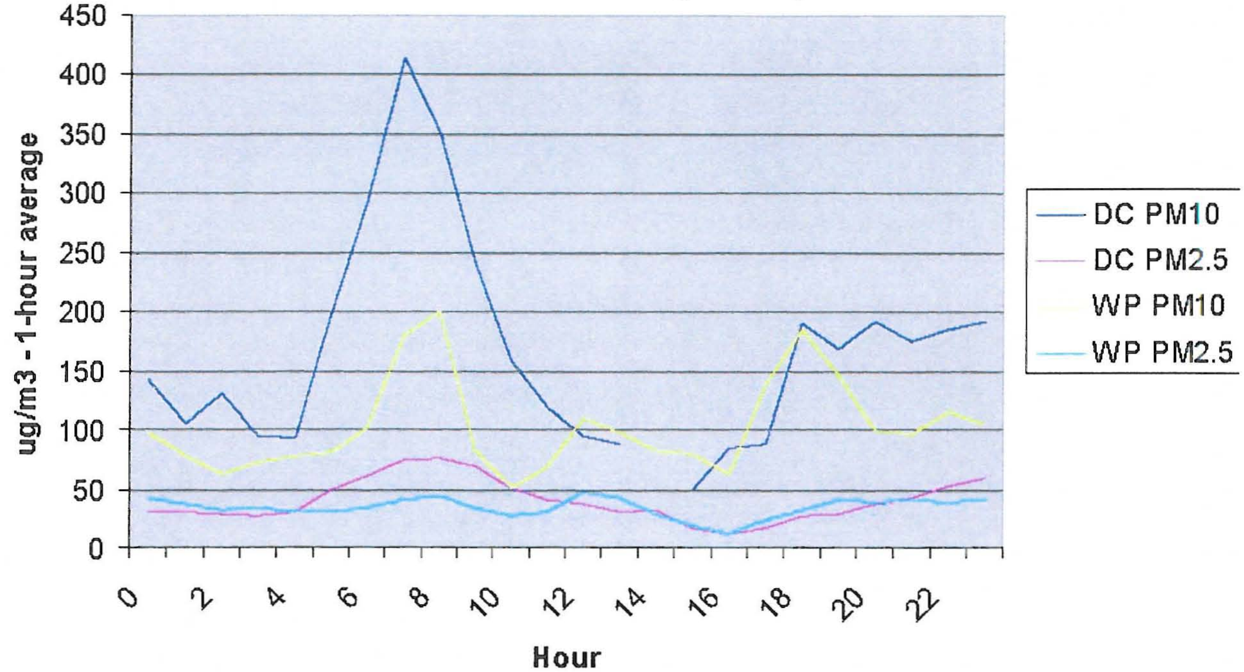
5.4 Background – Low Wind Days

During winter stagnant periods in the Salt River Area, wind speeds are sufficiently low so as to preclude the transport of significant quantities of PM-10 between major portions of the Maricopa PM-10 nonattainment area. The existence of wind, however, even at low speeds, suggests that some transport occurs. This analysis roughly quantifies mass transport of PM-10 to the Durango Complex monitor during one exceedance episode for which limited data are available.

PM-10 and PM-2.5 were measured continuously in 2006 at two sites in the nonattainment area: the Durango Complex and West Phoenix monitoring sites.[37] An exceedance of the federal 24-hour PM-10 standard was recorded, among other dates, on December 6, 2006 at the Durango Complex site. This date was chosen for analysis as it fell during the middle of an intensive field study conducted in the Salt River. A plot of hourly PM-10 and PM-2.5 ambient concentrations recorded at the two sites for that date is shown in Figure V-5-1.

[37] While PM-2.5 measurements are collected at multiple monitoring sites, only the Durango and West Phoenix sites collect hourly values, the remaining are 24-hour filter measurements. According to the County, PM-2.5 measurements at the Durango site prior to January 18, 2006, are not valid. For this reason, analysis of hourly PM-2.5 measurements during low wind conditions is restricted to December 2006 measurements.

Figure V-5-1
12/6/2006 PM-10 and PM-2.5 at Durango Complex and West Phoenix



A dramatic peak in PM-10 concentrations is seen to occur at 0800 hours at the Durango Complex site. Analysis indicates that this peak is due, to a large extent, to morning paved road travel under very stagnant wind and low mixing height conditions. A back trajectory analysis of air parcel movements prior to 0800 hours shows that the air parcel that arrived at the Durango Complex monitor at 0800 hours meandered within a radius of three miles of the monitor for the eight-hour period prior to this monitoring peak. During this interval, very little transport of suspended particulate into the Durango Complex modeling domain would have occurred. This situation was found to occur on the other days during the intensive field study period.

To quantify the mass transport of PM-10 to the Durango Complex monitor from sources outside the Salt River modeling domain with limited available data, Sierra made several assumptions with respect to the behavior of suspended particulate under the conditions present. These assumptions are outlined below.

- During winter stagnant wind conditions, the transit time of suspended particulate to the Durango Complex monitor averages eight hours, as reported by back trajectory analyses of several PM-10 hourly peaks recorded during the field study period.
- Suspended particulate under stagnant wind conditions settles out of the air at size-specific deposition velocities measured in static (i.e., no fluid flow) test conditions, which is supported by ADEQ's analysis of deposition velocities with respect to wind speed.[38]

[38] Understanding PMfine/PM-10 Ratios: Deposition from Localized Sources, P. Hyde, February 9, 2005

- The ambient particle size distribution 2.5 µm or smaller measured within the modeling domain is representative of the corresponding particle size distribution along the edges of the modeling domain.

- The gradient of PM-2.5 concentrations between the West Phoenix and Durango Complex monitors is linear during stagnant low wind conditions.

- Particulate within all size ranges is distributed uniformly within the mixing layer during transport across the modeling domain boundary.

To compute fractions of suspended particulate that would settle out of the air during the eight-hour transit time from the modeling domain boundary to the Durango Complex monitor during stagnant wind conditions, Sierra analyzed settling distances by particle size range. An online deposition velocity model was used to perform this calculation.[39] Inputs to the model included fluid density, fluid viscosity, particle diameter, and particle density. The density of air at a temperature of 53°F (the average daily temperature recorded at the Durango monitoring site on December 6, 2005) and an elevation of 1,030 ft (the elevation of the monitoring site as reported by the Google Earth website[40]) was found to be 0.0742 lb/ft^3 (1.189 kg/m^3), as computed by an online gas density calculator.[41] The viscosity of air at this temperature and elevation was computed by another online fluid dynamics calculator to be $1.80x10^{-5}$ kg/m-sec.[42] Particle density was assumed to be 2.65 gm/cc, the average soil particle density as reported in a soils science syllabus.[43] A tabulation of the computed deposition velocities and the settling distances over the eight-hour transport time from the modeling domain boundary to the Durango Complex monitor, by particle diameter, is presented in Table V-5-9.

The average mixing height measured in the Salt River Area during the period of 0000 and 0800 hours on December 6, 2006, was measured by a miniSODAR unit to be 28.8 meters. From Table V-5-9, it can be seen that all particles larger than 3.5 µm would settle out of the air during the 8-hour transport period from the modeling domain boundary to the Durango Complex during winter stagnant wind conditions.

[39] *http://www.filtration-and-separation.com/settling/settling.htm,* accessed on October 15, 2006.

[40] *http://www.earth.google.com*, accessed on October 15, 2006.

[41] *http://www.denysschen.com/catalogue/density.asp,* accessed on October 15. 2006.

[42] *http://www.lmnoeng.com/Flow/GasViscosity.htm,* accessed on October 15, 2006.

[43] *http://www.ju.edu.jo/ecourse/Lw%20Environment/Materials/lecture%2003.htm,* accessed on October 15, 2006.

Table V-5-9 Deposition Velocities and Settling Distances by Particle Size		
Particle Diameter μm	Deposition Velocity m/hr	8-hour Settling Distance M
10	28.9	231
8	18.5	148
6	10.4	83
4	4.6	37
3.5	3.5	28
3	2.6	21
2.5	1.8	14
2	1.2	9
1.5	0.65	5
1	0.29	2
0.5	0.07	1

To evaluate the fraction of particulate smaller than 3.5 µm that would settle out of the air during this transport period, Sierra evaluated the mass fractions within each of the size ranges between 0 and 3.5 µm. During the intensive Salt River Area field study conducted during December 2006, ambient concentrations of particulate within 53 size ranges between 0 and 20 µm were monitored with a laser-based particle counter. On December 4, 2006, this instrument collected data at the western boundary of the modeling domain, along 51st Avenue. Data from this location were considered to be representative of particle size distributions along the other boundaries of the modeling domain. Analysis of the distributions measured at other sites within the Salt River Area showed very little variation in the mass ratios of PM-2.5 to PM-3.5. The 51st Avenue data were evaluated to determine the mass within each 0.5 µm size range and then applied to PM-2.5 concentrations recorded on December 6 to quantify the mass within each size on this date. The mass distribution of particulate within each 0.5 µm size range, as measured by the laser particle counter on December 4, is shown in Table V-5-10.

Table V- 5-10
Fractional Mass Within Particle Size Ranges

Particle Size Range, µm	Mass Fraction
0.0 – 0.5	1.0%
0.5 – 1.0	5.5%
1.0 – 1.5	10.5%
1.5 – 2.0	15.9%
2.0 – 2.5	20.3%
2.5 – 3.0	23.5%
3.0 – 3.5	23.3%
Total	100.0%

The fractional mass of particles smaller than 3.5 µm that would settle out during the 8-hour transport period was computed by determining the fractions settling out by size range, multiplying these by the weight fractions, and summing over the products. Since the particles within each size range are assumed to be uniformly distributed within the mixing layer at the modeling domain boundary, the fraction settling out during transport would be equal to the fraction reaching the ground during this period. This was calculated by using an exponential decay function to simulate the mechanisms governing deposition. The equation[44] used to estimate the fraction reaching the ground is:

$$Cs(t) = Cs(0)*exp(-t*Vs/h)$$

[44] This equation was recommended by EPA Region 10 staff, email from Scott Bohning to Bob Dulla, September 27, 2007. The methodology was subsequently approved in a conference call with planning team members on October 1, 2007.

Where :

Cs(t) = the concentration of particles of a given size fraction at time t
Cs(0) = the concentration of particles of a given size fraction at the boundary of the modeling domain
t = the transit time from the boundary to the monitor (8 hours)
Vs = settling velocity for a given size fraction (in meters/hour)
h = distance from ground to mixing height (meters), which was computed to be 28.8 meters

The calculations used to estimate the fraction of mass settling out between the boundary of the modeling domain and the Durango monitor area are presented in Table V-5-11. The settling velocities calculated here are for the mid-size within each particle size range, and are different than those shown in Table V-5-9, which represent velocities at single particle diameters.

Table V-5-11
Mass Fraction of Particles Smaller than 3.5 µm Settling Out of the Air During 8-hour Transport From Modeling Domain Boundary to Durango Complex Monitor

Size Range µm	Avg. Settling Velocity m/hr	Settled Fraction	Mass Fraction	Settled Fraction x Mass Fraction
0.0 – 0.5	0.04	0.5%	1.0%	0.0%
0.5 – 1.0	0.18	4.0%	5.5%	0.2%
1.0 – 1.5	0.47	13.0%	10.5%	1.4%
1.5 – 2.0	0.90	23.9%	15.9%	3.8%
2.0 – 2.5	1.5	39.3%	20.3%	8.0%
2.5 – 3.0	2.2	41.7%	23.5%	9.8%
3.0 – 3.5	3.1	57.3%	23.3%	13.4%
Total				37.1%

This analysis shows that 37.1 percent of particles smaller than 3.5 µm will settle out of the air during the 8-hour transport period from the modeling domain boundary to the Durango Complex monitoring during winter stagnant conditions. From this analysis, it was also concluded that the PM-2.5 mass fraction of particles smaller than 3.5 µm is 53 percent, based on the laser-based particle size data at 51st Avenue shown in Table V-5-10.

The PM-2.5 concentration at the modeling domain boundary was linearly interpolated between the 24-hour concentrations recorded on December 6 and 7, 2006, at the West

Phoenix and Durango Complex monitoring sites. The interpolation was performed using the distances along a line connecting these two stations and the modeling domain boundary, which was originally designated as Van Buren Avenue. From distance measurements reported by Google Earth, the distance between the two monitors is 4.2 miles; the distances from West Phoenix and

Durango Complex to the modeling domain boundary are 2.4 and 1.8 miles, respectively. The PM-2.5 concentrations measured on each day at each monitor, and the concentrations estimated at the modeling domain boundary, are shown in Table V-5-12. As can be seen, this approach is conservative in that the values estimated for the boundary are higher than the concentrations recorded at the West Phoenix monitor.

Table V-5-12
PM-2.5 Concentrations on December 6 and 7, 2005
(μg/m³)

Date	West Phoenix	Durango Complex	Modeling Boundary
December 6, 2006	34.3	40.1	37.6
December 7, 2006	25.3	36.0	31.4

Since PM-2.5 is estimated to constitute 53 percent of all particles smaller than 3.5 μm, the corresponding $PM_{3.5}$ concentrations at the modeling domain boundary on December 6 and 7 were calculated to be 70.8 and 59.1 μg/m³, respectively. When a 37.1 percent reduction factor, representing the mass fraction settling out of the air during transport from the modeling domain boundary to the Durango Complex monitor, is applied to these two concentrations, the resulting particle mass concentration arriving at the Durango Complex monitor from sources outside the modeling domain—representing background conditions at this monitor during winter stagnant conditions—are computed to be 44.5 and 37.2 μg/m³ on December 6 and 7, 2006, respectively. The average background PM-10 over these two exceedance days is calculated to be 40.9 μg/m³.[45] The day-specific background levels

[45] This value is based on an analysis of conditions supporting the morning peak period only. Arguably, a similar analysis should be prepared for the mid-day and night time periods as well to quantify overall daily background levels. Mid-day transport from outside of the modeling domain, however, is not of concern because of the elevated mixing heights and resulting low concentrations, which contribute little to the 24-hour values. Night time transport, however, is more of a concern because of the elevated concentrations. A review of the night time conditions, however, shows them to be quite similar to the morning conditions already analyzed. The average mixing height between 4 pm and midnight is 30 meters as opposed to 28.8 height computed for the morning period. Similarly, the back trajectory analysis shows winds to be light and variable during night time hours and represent an 8-hour transit time to the boundary of the modeling

represent 26.2 percent and 21.4 percent of the total PM-10 readings recorded at Durango Complex on December 6 and 7, respectively.

Since valid PM-2.5 measurements from the two monitoring sites are available only for 2006 and the low wind conditions of December 6 and 7, 2006 are representative of the selected low wind episode design day conditions, the mean background value of 40.9 $\mu g/m^3$ was used to represent background throughout the modeling domain for December 12th and 13th 2005. This value represents 19.8 percent and 17.6 percent of the total PM-10 readings recorded at the Durango Complex and West 43rd monitors on December 12th and 24.6 percent and 24.4 percent on December 13th.

To distinguish between anthropogenic background and non-anthropogenic background, an analysis of Organ Pipe measurements was conducted. The IMPROVE monitoring network collects speciated measurements at 156 national parks and wilderness areas. Organ Pipe Cactus National Monument is located west southwest of Tucson. The location of the monitor has little anthropogenic activity and is 68 miles from Tucson. Filter measurements are collected every 3 days and measurements of both PM-10 and PM-2.5 concentrations are available (no hourly measurements are available). Data were downloaded from the IMPROVE network[46] for December 2005. PM-10 concentrations ranged between 3.58 and 22.16 $\mu g/m^3$ for the month. Insight from meteorological data was needed to determine which values were appropriate for representing non-anthropogenic activity on low wind days.

Unfortunately, no meteorological data are collected at the Organ Pipe monitoring site. Discussions with IMPROVE staff pointed to NOAA's Air Resources Laboratory READY (Real-time Environmental Applications and Display system) website as a meteorological data source for Organ Pipe.[47] READY contains archived meteorology for North America and is able to provide modeled values for selected latitude and longitude coordinates. Lacking access to meteorological measurements at sites located in the vicinity of Organ Pipe, READY values were obtained for the Organ Pipe coordinates. Wind roses were obtained for each day in December, 2005 that measurements were collected at Organ Pipe.

Table V-5-13 presents a summary of the Organ Pipe PM-10 measurements, meteorological data obtained from READY, and measurements used to quantify non-anthropogenic background values. A review of the meteorological conditions at the Durango and West 43rd monitoring stations on December 12, 2005, showed that the mean 24-hour wind speed was 1.3 and 1.6 mph at the Durango and West 43rd monitoring sites,

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domain. For these reasons, the analysis of morning-only conditions is considered representative of the two periods of the day that cause an exceedance of the ambient PM-10 standard.

[46] *http://vista.cira.colostate.edu/improve/default.htm*

[47] *http://www.arl.noaa.gov/ready/ametus.html*

Table V-5-13
Summary of IMPROVE Measurements and READY Values for Organ Pipe Monitoring Site Used to Estimate Non-Anthropogenic Background for the December 12, 2005 Low Wind Design Day

Date	PM-10 (µg/m^3)	Max Wind Speed (mph)	% of Time At Max Speed	% of Time At Calm	Values Selected
12/03/05	6.60	11-16	N/A	N/A	-
12/06/05	3.58	4-6	21	11	3.58
12/09/05	22.16	7-10	N/A	N/A	-
12/12/05	14.11	4-6	20	11	14.11
12/15/05	16.87	4-6	33	0	-
12/18/05	13.34	4-6	64	0	-
12/21/05	9.08	17-21	N/A	N/A	-
12/24/05	9.70	7-10	N/A	N/A	-
12/27/05	10.29	4-6	60	0	-
12/30/05	6.97	7-10	N/A	N/A	-
Mean Value					8.85

with peak values of 3.7 and 3.6 mph, respectively. Winds averaging above 3 mph lasted only one hour at both sites. A review of the December wind speed values shows that no days at Organ Pipe had maximum mean hourly wind speeds below the 4-6 mph range. Of the five days with maximum wind speeds in the 4-6 mph range, only two days exhibited any hours at calm. Since conditions in the Salt River Area were clearly stagnant on December 12, 2005, values from both days were selected to estimate non-anthropogenic background concentrations. Given the elevated wind speeds on these days relative to those recorded at the Salt River monitors, these values represent conservative estimates of non-anthropogenic concentrations.

The resulting daily average non-anthropogenic value of 8.85 $\mu g/m^3$ must then be contrasted with the overall daily average background concentration computed to be impacting the Salt River modeling domain. When contrasted with the average daily background value of 40.9 $\mu g/m^3$, the anthropogenic share of the background is computed to be 78.4 percent [(40.9 – 8.85)/40.9].

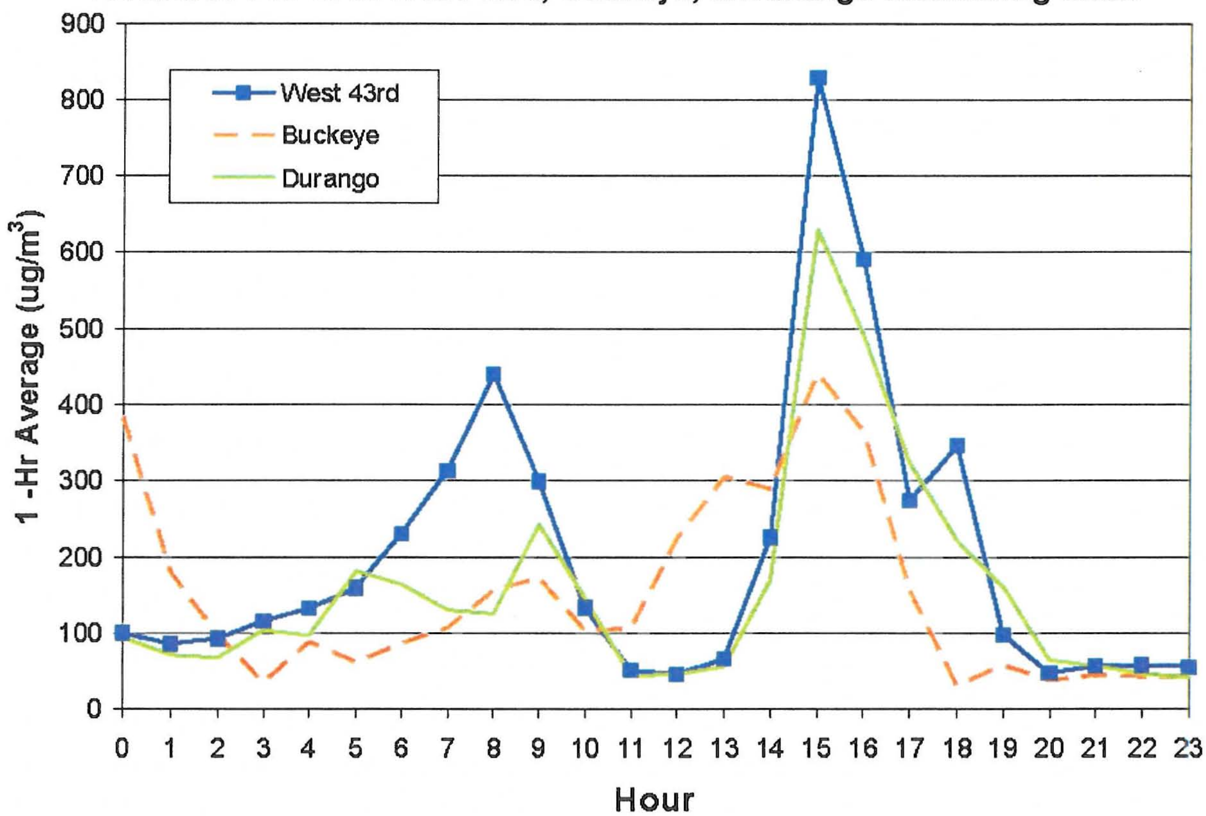
5.5 Background – High Wind Day

MAG elected to perform additional modeling for the high wind day of February 15, 2006, and include the results in the Five Percent Plan. This day was selected because it represents the highest non-flagged PM-10 concentration on a high wind day in 2005–2006. Both the West 43rd and Durango monitors exceeded the 24-hour PM-10 standard on that day with concentrations of 202 $\mu g/m^3$ and 160 $\mu g/m^3$, respectively.

A review of conditions on February 15, 2006, shows that winds were not consistent throughout the day. The morning experienced light and variable winds much like a December stagnation day. In the afternoon winds shifted to the southwest and for a five-hour period remained uniformly high between 13–15 mph, before dropping off in the late evening hours. During the high wind portion of the day, the only monitor outside of the modeling domain providing upwind measurements was Buckeye. Based on Google Earth measurements, the Buckeye monitor is 27.7 miles southwest of the West 43rd monitor and 29.4 miles from the Durango monitor. A plot of hourly PM-10 ambient concentrations recorded at all three sites for that date is shown in Figure V-5-2.

As with low wind stagnation days, a strong peak in PM-10 concentrations is seen to occur at 0800 hours at the West 43rd site. The increase in morning concentrations, while less pronounced, is also visible at the Durango site. The morning increase at both sites is the result of a combination of low mixing heights, light and variable winds, and source activity adjacent to the monitor. During this period there is little transport of suspended particulate into the modeling domain, and concentrations recorded at the Buckeye monitor are not relevant to preparing estimates of background concentrations. The peak concentration recorded in the morning at both West 43rd and the Durango monitors decays rapidly as the ground warms, the mixing height increases and morning activity within the modeling domain tapers off. The afternoon, however, witnesses a dramatic increase in PM-10 levels as the winds increase to 15 mph. During this time the peak concentration at West 43rd exceeds 800 μg/m³, which is more than double the morning peak. That peak, however, decays as abradable material from disturbed surfaces upwind of the monitor is exhausted. A similar pattern is seen at the Durango monitor. During this period, the wind is coming from the direction of the Buckeye monitor and measurements recorded there are relevant for preparing estimates of the mass transport of material into the modeling domain.

Figure V-5-2
2/15/2006 PM-10 at West 43rd, Buckeye, & Durango Monitoring Sites



A review of concentrations at the Buckeye monitor shows the diurnal profile of ambient concentrations is different from that at both the West 43rd and Durango monitors. At the beginning of the day, the Buckeye monitor records a steep decline in ambient concentrations, which is the opposite of what is seen at West 43rd and Durango (and confirms that Buckeye values during this time are not relevant to estimating Salt River background concentrations). The morning peak is later and less pronounced at Buckeye; the high wind increase starts earlier and produces much less of a peak than recorded at West 43rd and Durango. The difference in peak concentrations recorded at the monitors speaks to the differences in disturbed land located upwind of the monitors. Clearly, there is more disturbed land upwind of the West 43rd and Durango monitors than there is upwind of the Buckeye monitoring site.

To obtain a better understanding of the conditions occurring at the monitoring sites, it is useful to contrast wind speed and wind direction, as well as concentrations recorded at both monitors. Table V-5-14 provides an hourly listing of these values for the West 43rd and Buckeye monitors.

Table V-5-14
Comparison of West 43rd and Buckeye Monitor Site Measurements
February 15, 2006

Hour	West 43rd			Buckeye		
	Wind Speed	Wind Direction	PM-10 µg/m³	Wind Speed	Wind Direction	PM-10 µg/m³
0	4	59	100.5	2.5	49	384.3
1	3	59	86.0	2.4	67	180.0
2	0.4	165	93.1	4.9	85	99.4
3	0.5	163	115.8	5.3	54	35.9
4	1.3	79	132.9	4.2	79	88.9
5	2.2	157	159.4	6.3	78	62.2
6	1.8	135	230.6	6.7	74	86.4
7	0.6	184	314	7.6	67	107.4
8	3.2	287	440.6	5.1	71	156.3
9	4.6	276	299.3	2.8	113	173.0
10	5.2	286	133.5	2	274	103.7
11	3.2	293	51.5	9.2	263	107.0
12	2	287	46.6	13	231	225.7
13	3.5	302	66.5	14.7	219	306.1
14	9.6	243	225.8	16.7	227	289.4
15	15.5	239	829.4	17.7	220	441.4
16	14.6	246	591	18.6	227	365.7
17	15.1	255	274.3	15.6	237	156.8
18	14.4	257	346.2	16.8	260	32.1
19	12.7	277	97.5	10.3	256	58.3
20	5.7	275	48.0	6.1	246	38.8
21	3.1	242	57.0	4.4	282	45.5
22	8.8	226	57.8	8.3	241	43.6
23	8.3	224	56.0	7.7	279	43.5

To review the data, it is useful to break the day into consistent periods of activity (defined on the basis of conditions at the West 43rd monitor); a total of four are shown:

1. Early morning, the hours preceding 0800, display light and variable winds;
2. 0800–1300 hours, the winds stabilize and are consistently from the southwest;
3. 1400–1900 hours, the winds are consistently high and from the southwest; and
4. 2000–2300 hours, wind speeds decline, but remain from the southwest.

While there are similarities between the West 43rd and Buckeye measurements, there are also differences and they need to be considered in choosing which datasets to use in calculating period-specific background values. During the early morning hours, Buckeye wind speeds are consistent and uniformly from the northeast, whereas at West 43rd they are light and variable. These differences, combined with the opposite trends in observed concentrations, confirm that Buckeye should not be used to represent Salt River background values during this period. In the succeeding period, between 0800 and 1300 hours, Buckeye winds begin to increase as do monitored concentrations, in contrast to West 43rd where concentrations are declining. These differences again confirm that Buckeye should not be used to represent Salt River background values during this period. Peak wind speeds and concentrations occur at both monitors during the high wind hours, between 1400 and 1900 hours; profiles of hourly concentrations also follow a similar pattern of rise and fall. The wind directions are also consistent during this period. The consistency in trends supports the use of Buckeye concentrations to represent background values during this time period. Finally, during the late night hours, wind speeds, directions, and monitored concentrations are similar at both monitors. This consistency supports the use of Buckeye to represent background impacting the Salt River Area during this period.

Unlike the low wind days, where measurements of both PM-2.5 and PM-10 concentrations were available to evaluate deposition occurring between the West Phoenix and Durango Complex monitoring sites, no comparable measurements are available to assess deposition occurring over a much longer distance, but much shorter transit time between West 43rd and Buckeye monitoring sites. Clearly, some deposition of heavier particles will occur during the <2 hour transit time. However, there is a substantial area of disturbed surface between the Buckeye monitor and the edge of the modeling domain to replace material that settled out during transit. Lacking additional measurements during these conditions, this assumption, which is admittedly crude, will have to suffice.

In light of the information presented above, it is recommended that background values be computed for three separate periods of the day using the following data sources:

1. *Morning (0000–1300 hours)* – While there are differences in wind speed and direction between the early and later morning hours, the diurnal pattern in concentrations is very similar to that observed on stagnation days in December. In addition, a review of mixing heights indicates that levels were uniformly low through the morning peak and then rose rapidly in the succeeding hours. For this reason,

the low wind background value estimated for December 6 and 7, 2005 should be used for these hours.

2. *High Wind (1400–1900 hours)* – Given the consistency in wind speed, direction, and the rise and fall in concentrations observed at both sites, the Buckeye values should be used to calculate background for this period. A careful review of the wind data suggests that the Buckeye concentrations should be lagged for a 1 to 2 hour period to account for differences in the time the winds start increasing and the transit time between the monitors. A review of the concentration data, however, shows that peak concentrations occur at the same hour for all three monitors. More importantly, the uncertainty in the amount of material deposited and replaced during the transit period between Buckeye and the Salt River modeling domain outweighs any refinement provided by lagging Buckeye hours. For this reason, Buckeye measurements for the same time period (i.e., 1400 – 1900 hours) should be used to compute background.

3. *Late Night (2000–2300 hours)* – Given the consistency in wind speed, direction, and monitored concentrations during this period, the Buckeye values should be used to calculate background for this period.

A summary of the recommended mean hourly background values for each period is presented in Table V-5-15, along with a comparison to mean hourly concentrations recorded at the West 43rd and Durango monitoring sites for February 15, 2006.

Table V-5-15
Relation Between West 43rd and Durango PM-10 Levels and Recommended Background Values
February 15, 2006

Hours	µg/m^3	Background µg/m^3	Share
West 43rd			
0 – 13	162.2	40.9	25.2%
14 – 19	394.0	224.0	56.9%
20 – 23	54.7	42.9	78.4%
Durango			
0 – 13	112.5	40.9	36.4%
14 – 19	332.7	224.0	67.3%
20 – 23	52.8	42.9	81.3%

As can be seen, the estimates of background vary considerably by time of day. In the morning hours, they are low and account for 25 percent of the concentrations recorded at the West 43rd monitor and 36 percent at the Durango monitor. In the afternoon, during the high wind conditions, the background estimate increases substantially and accounts for 57 percent of the recorded concentrations at West 43rd and 67 percent at Durango. During the late evening hours, the estimate of background declines substantially but accounts for the largest share of the concentrations recorded at both monitors. While the 78–81 percent share appears high, its impact on estimating the overall daily concentration is quite limited.

A review of the area upwind of the Buckeye monitoring site shows that during the high wind hours, it is mostly agricultural land with clear boundaries roughly 1 mile to the south and 6 miles to the west. Beyond those boundaries, there is no discernable disturbed surface, just desert land. To distinguish between anthropogenic background and non-anthropogenic background, an analysis of Organ Pipe measurements was conducted. The IMPROVE monitoring network collects speciated measurements at 156 national parks and wilderness areas. Organ Pipe is a National Monument located 68 miles southwest of Tucson that has little anthropogenic activity. Filter measurements are collected every 3 days and measurements of both PM-10 and PM-2.5 concentrations are available. Data were downloaded from the IMPROVE network[48] for February 2006. No measurements were collected for February 15, 2006. PM-10 concentrations ranged between 6.03 and 32.17 $\mu g/m^3$ for the month. Insight from meteorological data was needed to determine which values were appropriate for representing non-anthropogenic activity.

As noted in the preceding section on background during low wind days, there was a lack of meteorological measurements in the vicinity of Organ Pipe; therefore, READY values were obtained for the Organ Pipe coordinates and wind roses were obtained for each day in February 2006 that measurements were collected at Organ Pipe.

Table V-5-16 presents a summary of the Organ Pipe PM-10 measurements, meteorological data obtained from READY, and measurements used to quantify non-anthropogenic background values. A review of the meteorological conditions at the Durango and West 43rd monitoring stations on February 15, 2006, showed that the mean 24-hour wind speed was 6.0 mph at both sites, with peak values of 15.5 mph at both sites. Both sites experienced high winds ranging between 11 and 15 mph for 6 hours. A review of the February wind speed values shows that only 2 days had wind speeds in the range of 11-16 mph. As shown in Table V-5-16, they produced an average non-anthropogenic background value of 22.35 $\mu g/m^3$ under high wind conditions.

To determine the split between anthropogenic and non-anthropogenic background, it is first necessary to compute a 24-hour average background value from the three daily time periods displayed in Table V-5-14. Using weight values based on each time period's share of the day (e.g., the morning period of 0-13 hours produced a weight equal to 14/24 or 0.583) which were applied to the background value selected to represent each time period (e.g., in the morning this is 40.9 $\mu g/m^3$), the average daily background value was computed to be 87.0 $\mu g/m^3$. When contrasted with the non-anthropogenic background value estimate from Organ Pipe, the anthropogenic share of background is computed to be 74.3 percent [(87.0 – 22.35)/87.0].

[48] *http://vista.cira.colostate.edu/improve/default.htm*

Table V-5-16
Summary of IMPROVE Measurements and READY Values for Organ Pipe Monitoring Site Used to Estimate Non-Anthropogenic Background for the February 15, 2006 High Wind Design Day

Date	PM-10 (µg/m^3)	Max Wind Speed (mph)	% of Time At Max Speed	Values Selected
02/01/06	10.51	7-10	N/A	-
02/04/06	9.25	4-6	N/A	-
02/07/06	9.07	7-10	N/A	-
02/10/06	8.31	7-10	N/A	-
02/13/06	11.09	7-10	N/A	-
02/16/06	32.17	11-16	11%	32.17
02/19/06	6.75	7-10	N/A	-
02/22/06	8.27	7-10	N/A	-
02/25/06	12.52	11-16	11%	12.52
02/28/06	6.03	4-6	N/A	-
Mean Value				22.35

5.6 Model Performance

AERMOD was configured with the meteorological inputs and emission inventories described above and used to estimate each source's contribution to hourly concentrations on each of the design days for each of the monitoring sites. The hourly concentrations were then combined with the estimates of background described above and contrasted with the hourly and daily concentrations recorded at the three monitoring sites to assess model performance. Figures V-5-3 through V-5-9 provide a summary of how well model predictions compare with measured concentrations on an hourly basis. The figures display each source category's contribution to the predicted hourly concentration. Except for the high wind day, background values are included at a constant hourly concentration. Listed below is a brief set of comments on each of the figures.

- *Durango Complex (December 12, 2005)* – Figure V-5-3 shows reasonable agreement between predicted and measured values on a diurnal basis. Key differences are the overprediction of the morning peak and the underprediction of late night concentrations. These are largely the result of differences between measured values and diurnal estimates of travel activity in 2005. Another contributor to the overestimate in the morning appears to be an inflated estimate of emissions from industrial area sources. In the process of investigating the cause, it was determined that industrial sources located several miles upwind (at 10 am, the wind was coming from the southwest) were shown to be impacting the monitor, even though the wind speed was 0.6 mph (per AERMET). Based on this review, it appears that AERMOD does not limit receptor impacts to sources located within an hour's travel distance (based on wind speed). Instead, it appears that all characterized upwind sources will impact a receptor each hour regardless of their distance from the receptor. This indicates the impact of some sources on the monitor(s) is overpredicted. The magnitude depends on the distance between source and receptor, wind speed and wind direction. While insufficient time was available to investigate the extent of this issue, it is a concern only under low wind speeds. At higher speeds, this inconsistency disappears.

- *West 43rd Avenue (December 12, 2005)* – As shown in Figure V-5-4, the poorest model performance occurs for this monitor and date. The emissions inventory, in combination with the meteorological inputs, fails to account for the "double hump" in the measured data. Given the low recorded wind speeds, it appears to be the result of a "localized event." A contributing factor may also be that AERMOD cannot adequately characterize source contributions over an hour at low wind speeds using a single average wind direction, since wind direction (and source contributions) may have been frequently changing during that hour (as seen in the 5-minute wind data collected in the December 2006 field study).

- *Bethune Elementary School (December 12, 2005)* – Figure V-5-5 shows the diurnal source contributions predicted by the model, but no diurnal profile of measured concentrations. That is because the measurements at that site were collected on a filter and only a 24-hour value is available. It is expected that the morning peak is overpredicted; the cause aside from the limitations noted above is not clear.

- *Durango Complex (December 13, 2005)* – Missing from Figure V-5-6 is the strong morning peak in both measured and modeled concentrations evident in the previous figures. AERMOD underpredicts the elevated concentrations recorded during late night and early morning hours when anthropogenic activity is low. The agreement between modeled and measured values during the day when anthropogenic activity is higher, however, is good.

- *West 43rd Avenue (December 13, 2005)* – Figure V-5-7 shows that AERMOD underpredicts the concentrations recorded throughout most of the day. Despite the underprediction, the diurnal profile of predicted concentrations tracks well with those of the measured concentrations. Again, the greatest shortfall occurs during the late night and early morning hours when anthropogenic activity is lowest.

- *Durango Complex (February 15, 2006)* – The first notable feature of Figure V-5-8 is the difference in hourly background concentrations. The second is the uncharacteristic early overprediction of the morning peak. Since the morning hours have low wind conditions similar to the December 2005 episode, the issues noted for those days could be contributing to the differences seen. The inability to predict the sharp rise in afternoon concentrations caused by the onset of the high winds is thought to be caused by the failure of the wind-dependent emission factor algorithm in AERMOD to duplicate the initial hour spike in windblown emissions and the depletion of surface particles available for entrainment in subsequent hours even when average hourly wind velocities increase.

- *West 43rd Avenue (February 15, 2006)* – Figure V-5-9 shows that AERMOD underpredicted the peak morning concentrations and had a delayed prediction of the afternoon peak. The same concerns noted for the Durango Complex on this date apply at West 43rd Avenue.

The next step in the analysis was to normalize the source-specific predictions to account for the overall difference between predicted and measured values on a 24-hour basis. Tables V-5-17 through V-5-19 list the predicted and normalized 24-hour average concentration from each source. As can be seen, the calculations were performed by first netting out the impact of the background value so that it would remain unchanged. The results of these calculations provide a 2005/2006 baseline for projecting the impacts of growth to 2010. These calculations are documented in the section on the Attainment Demonstration.

Figure V-5-3
Comparison of Diurnal Distribution of Measured Concentrations and AERMOD Predicted Source Concentrations for Durango Complex (December 12, 2005)

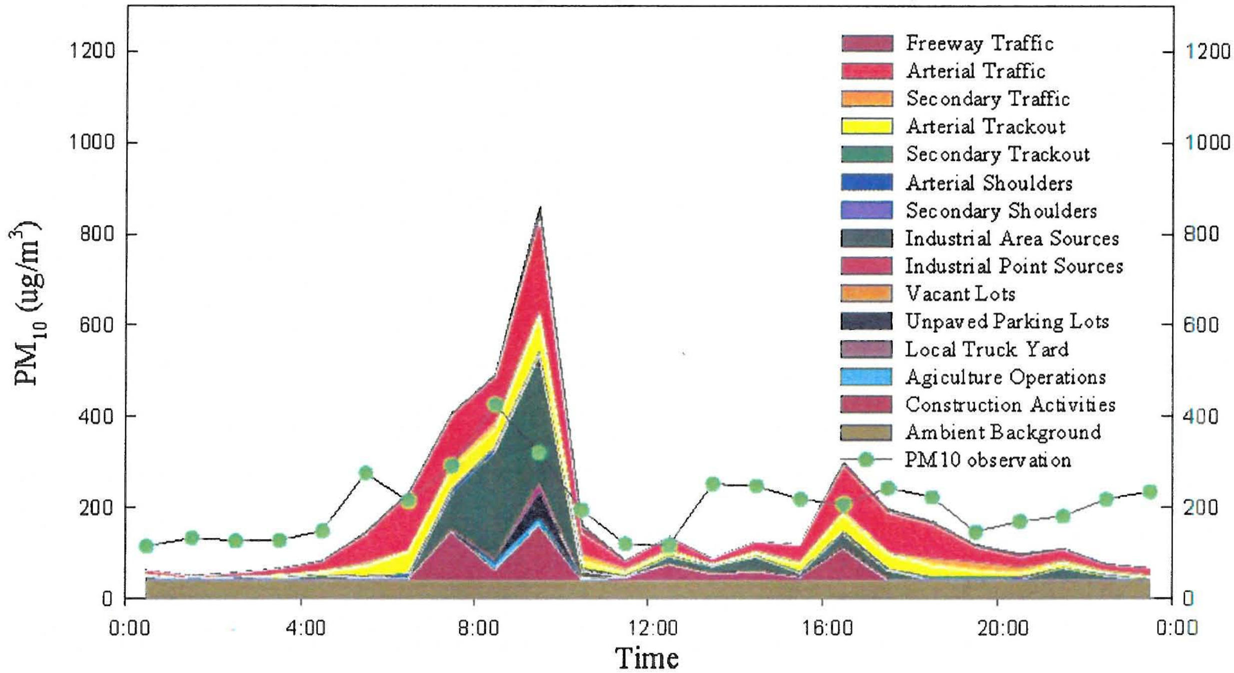


Figure V-5-4
Comparison of Diurnal Distribution of Measured Concentrations and AERMOD Predicted Source Concentrations for West 43rd Avenue (December 12, 2005)

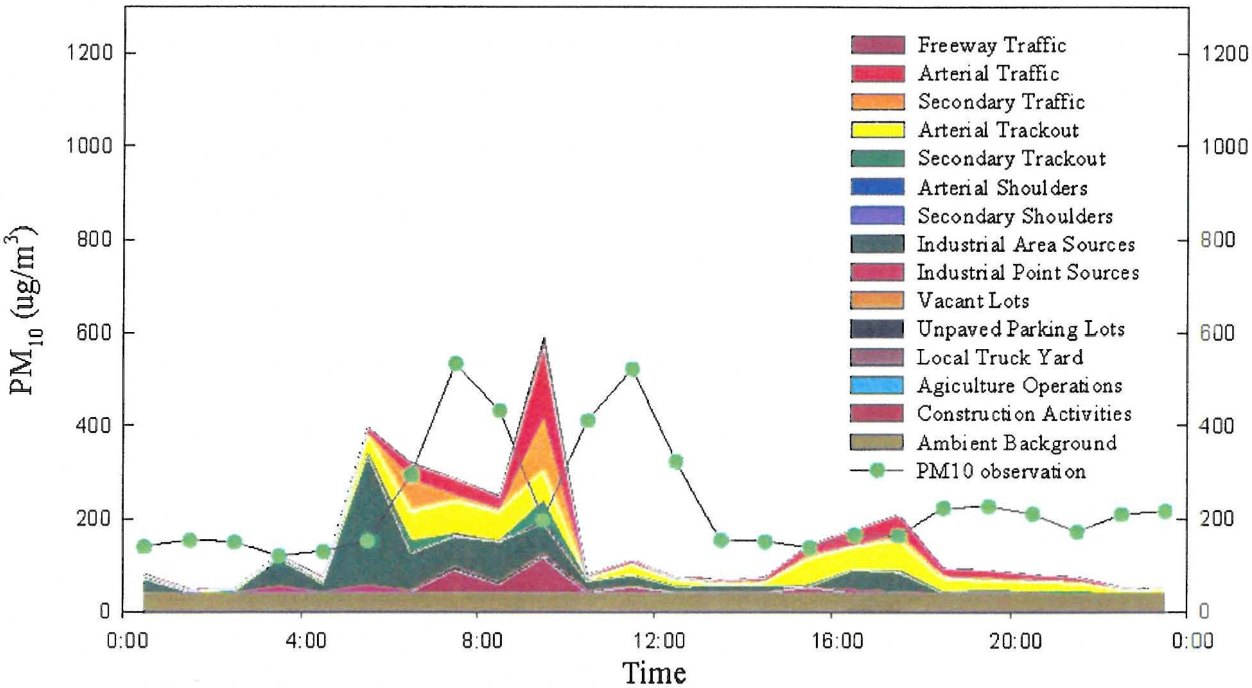


Figure V-5-5
Diurnal Distribution AERMOD Predicted Source Concentrations for Bethune Elementary School (December 12, 2005)

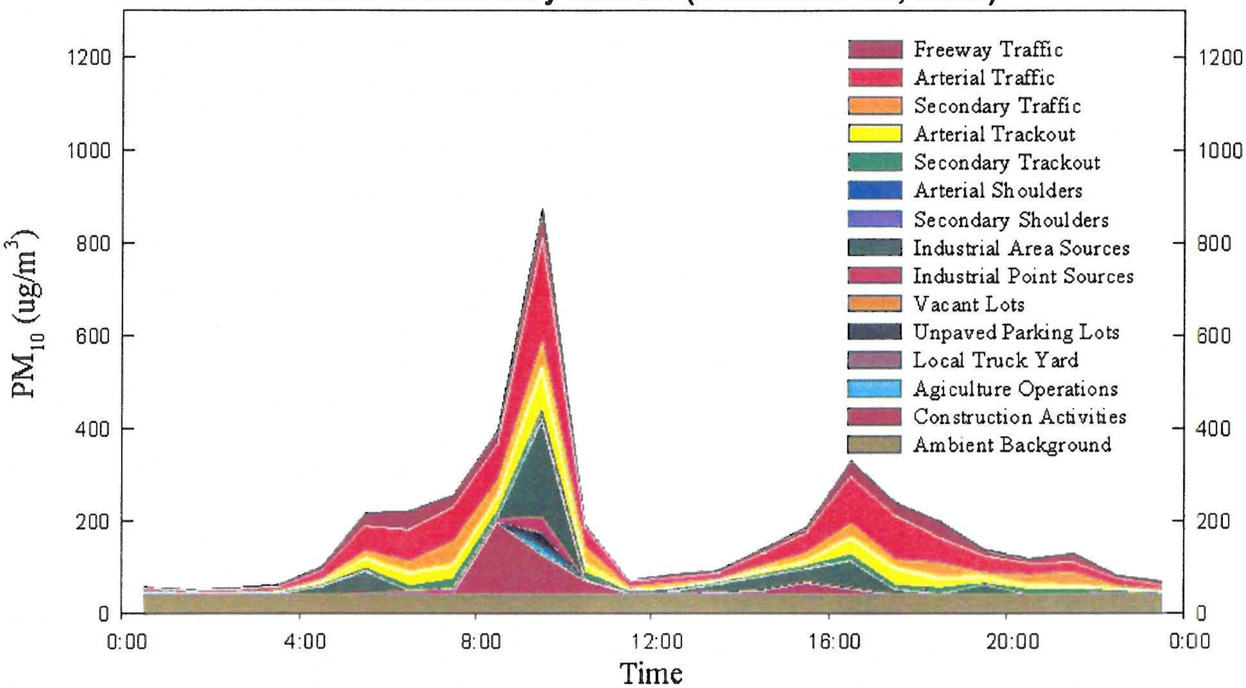


Figure V-5-6
Comparison of Diurnal Distribution of Measured Concentrations and AERMOD Predicted Source Concentrations for Durango Complex (December 13, 2005)

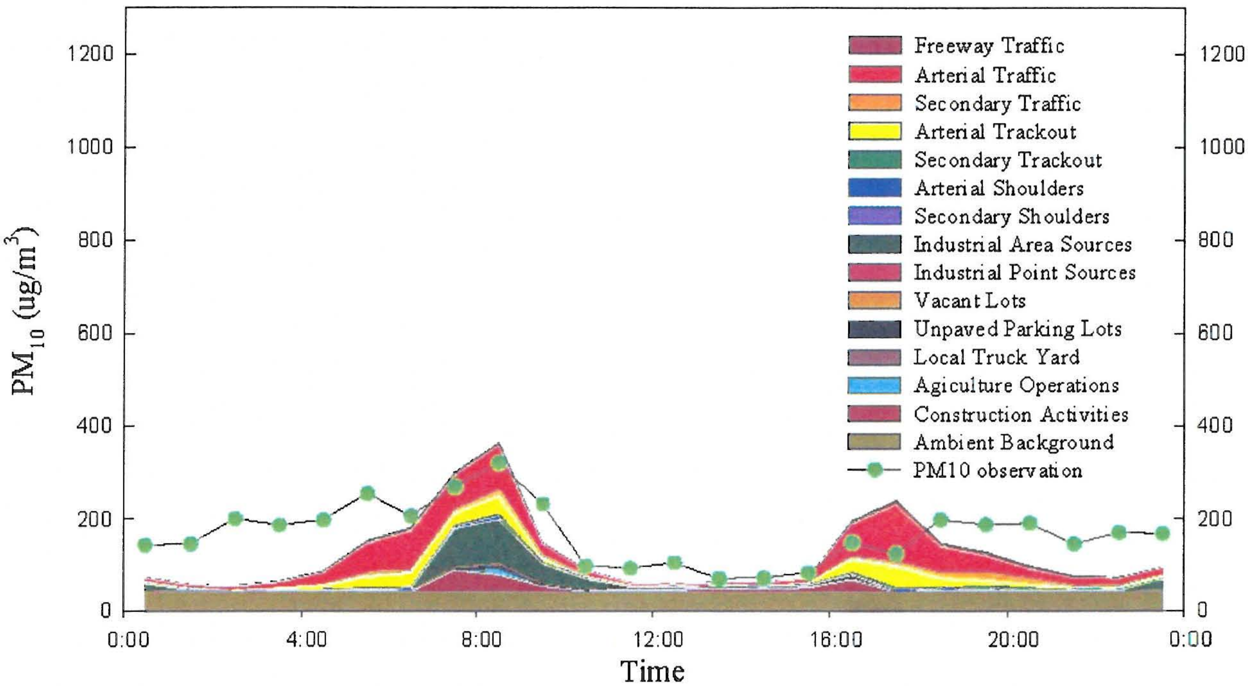


Figure V-5-7
Comparison of Diurnal Distribution of Measured Concentrations and AERMOD Predicted Source Concentrations for West 43rd Avenue (December 13, 2005)

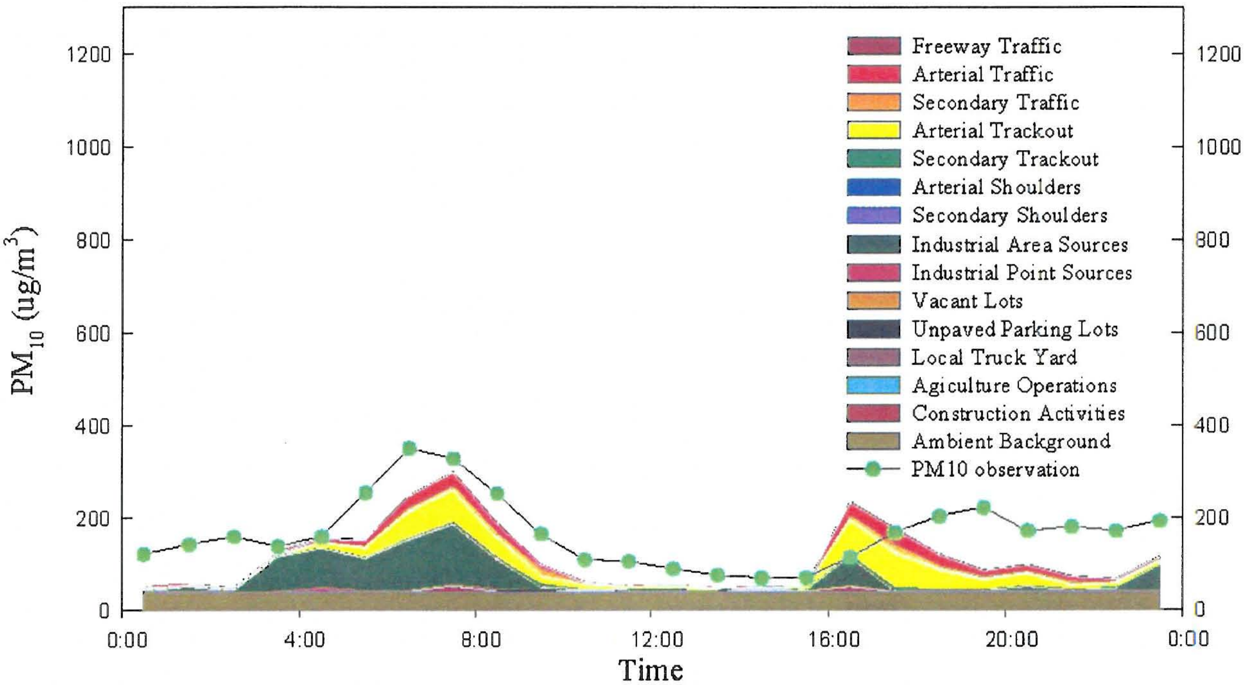


Figure V-5-8
Comparison of Diurnal Distribution of Measured Concentrations and AERMOD Predicted Source Concentrations for Durango Complex (February 15, 2006)

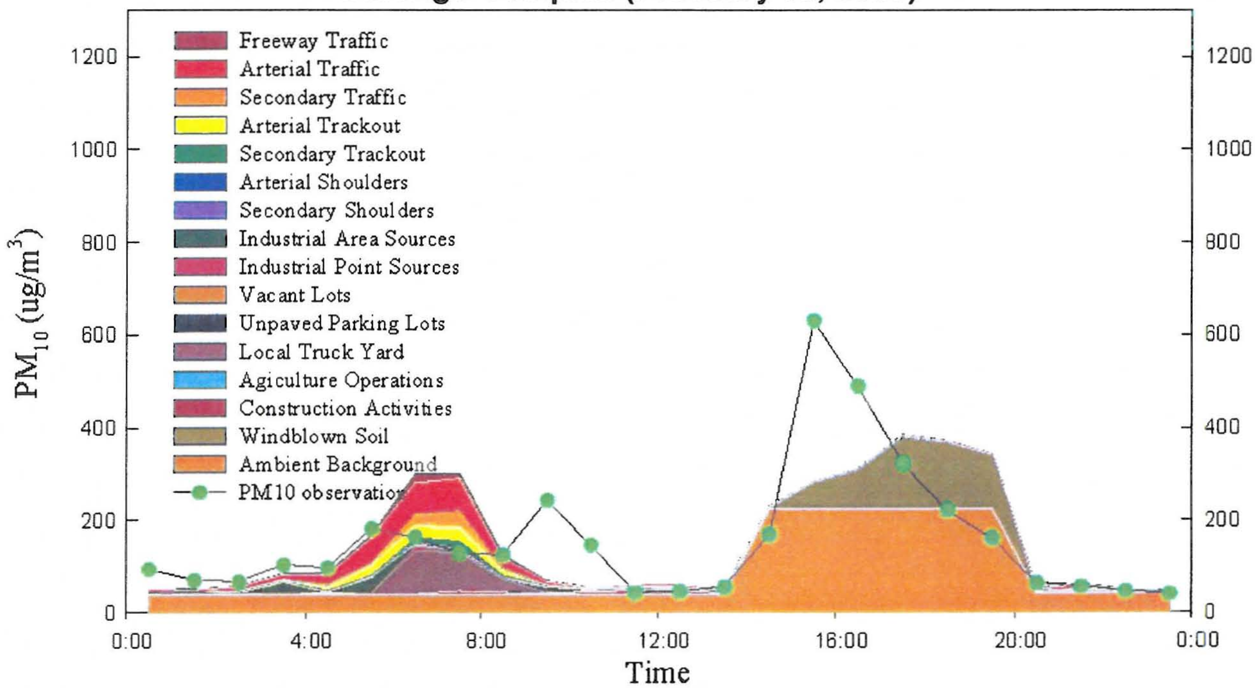


Figure V-5-9
Comparison of Diurnal Distribution of Measured Concentrations and AERMOD Predicted Source Concentrations for West 43rd Avenue (February 15, 2006)

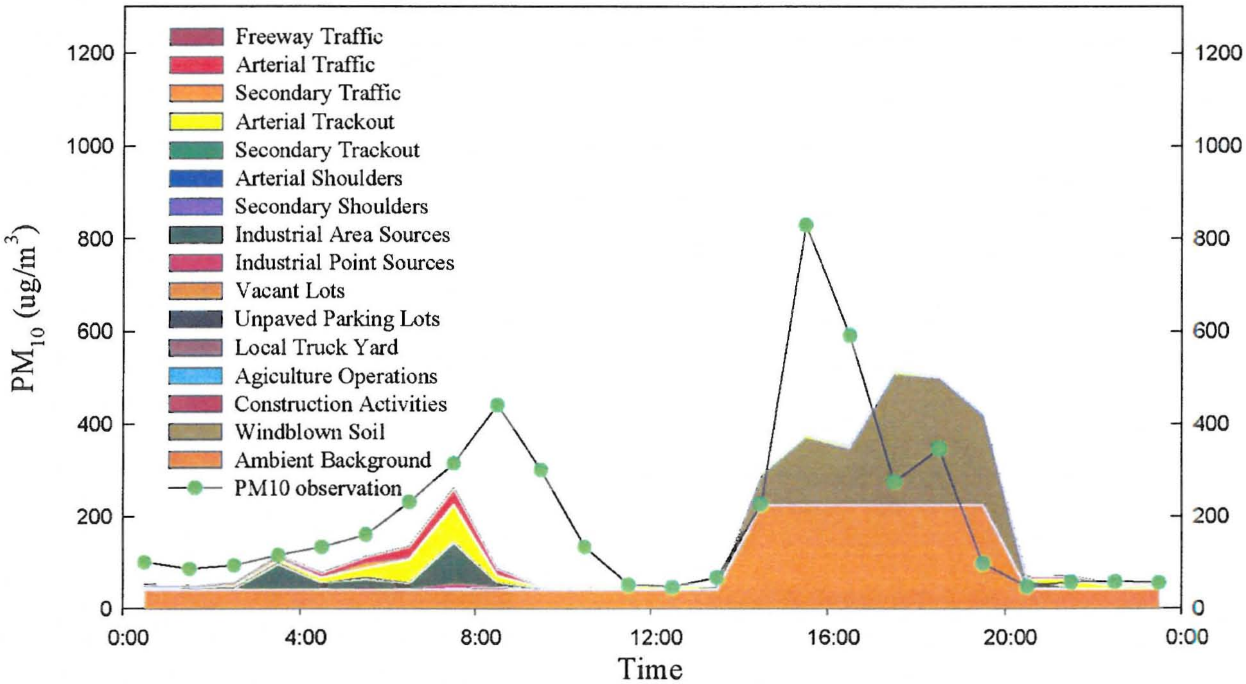


Table V-5-17 Low Wind Design Day (Dec. 12, 2005) Modeling Summary (µg/m³)						
Source Category	Durango Complex		West 43rd Avenue		Bethune Elementary School	
	Model Prediction	Prediction Normalized to Measured Concentration	Model Prediction	Prediction Normalized to Measured Concentration	Model Prediction	Prediction Normalized to Measured Concentration
Freeway Traffic	5.12	6.19	1.60	2.75	15.98	17.92
Arterial Traffic	48.68	58.77	18.92	34.09	43.16	48.36
Secondary Traffic	5.66	7.01	9.94	16.72	18.73	21.05
Arterial Trackout	18.96	22.89	27.97	51.90	17.76	19.90
Secondary Trackout	2.03	2.52	3.57	6.00	6.72	7.55
Arterial Shoulders	2.44	2.94	0.65	1.14	0.46	0.52
Secondary Shoulders	0.08	0.10	0.16	0.26	0.31	0.35
Industrial Area Sources	32.08	37.95	34.87	60.49	18.14	20.13
Industrial Point Sources	1.99	2.45	3.41	6.41	3.44	3.85
Vacant Lots	0.02	0.03	0.02	0.03	0.00	0.01
Unpaved Parking Lots	3.29	3.86	0.46	0.76	1.36	1.49
Agricultural Operations	1.43	1.68	0.16	0.26	0.87	0.96
Construction Activities	16.54	19.57	6.85	11.39	13.58	15.01
Local Truck Yard	0.00	0.00	0.00	0.00	0.00	0.00
Ambient Background	40.90	40.90	40.90	40.90	40.90	40.90
Total	179.24	206.86	149.48	233.09	181.41	198.00

Table V-5-18
Low Wind Design Day (Dec. 13, 2005) Modeling Summary
($\mu g/m^3$)

Source Category	Durango Complex		West 43rd Avenue	
	Model Prediction	Prediction Normalized to Measured Concentration	Model Prediction	Prediction Normalized to Measured Concentration
Freeway Traffic	2.74	4.31	0.52	0.94
Arterial Traffic	33.44	51.98	10.92	19.34
Secondary Traffic	4.53	7.11	3.19	5.67
Arterial Trackout	13.10	20.37	24.41	44.27
Secondary Trackout	1.63	2.55	1.15	2.04
Arterial Shoulders	1.69	2.63	0.37	0.64
Secondary Shoulders	0.06	0.10	0.04	0.08
Industrial Area Sources	13.53	20.81	29.10	48.72
Industrial Point Sources	1.37	2.37	1.45	2.75
Vacant Lots	0.00	0.00	0.00	0.00
Unpaved Parking Lots	0.76	1.31	0.03	0.05
Low Truck Yard	0.00	0.00	0.00	0.00
Agricultural Operations	0.83	1.22	0.06	0.14
Construction Activities	6.60	10.40	1.17	2.17
Ambient Background	40.90	40.90	40.90	40.90
Total	121.20	166.07	113.31	167.72

Table V-5-19
High Wind Design Day (Feb. 15, 2006) Modeling Summary
($\mu g/m^3$)

Source Category	Durango Complex		West 43rd Avenue	
	Model Prediction	Prediction Normalized to Measured Concentratio n	Model Predictio n	Prediction Normalized to Measured Concentration
Freeway Traffic	2.06	2.22	0.26	0.42
Arterial Traffic	13.26	14.53	4.97	7.63
Secondary Traffic	3.98	4.29	1.53	2.44
Arterial Trackout	5.42	5.94	11.72	18.61
Secondary Trackout	1.43	1.54	0.55	0.87
Arterial Shoulders	0.82	0.90	0.19	0.28
Secondary Shoulders	0.05	0.05	0.02	0.03
Industrial Area Sources	3.82	4.27	9.17	13.05
Industrial Point Sources	0.82	0.89	1.07	1.62
Vacant Lots	0.02	0.03	0.00	0.00
Unpaved Parking Lots	0.41	0.50	0.00	0.00
Local Truck Yard	8.59	9.04	0.00	0.00
Agricultural Operations	0.07	0.08	0.06	0.12
Construction Activities	1.48	1.67	0.56	1.00
Windblown Alluvial Soil	0.18	0.22	4.80	7.25
Windblown Soil:				
Agriculture	0.07	0.08	0.00	0.00
Construction	0.98	1.10	0.41	0.66
Industry	2.62	2.99	20.56	31.30
Unpaved Parking Lots	17.37	19.66	0.05	0.09
Vacant Lots	0.53	0.60	13.22	20.50
Road Shoulders	0.00	0.00	5.71	9.32
Background	87.01	87.01	87.01	87.01
Total	151.00	157.58	161.85	202.22

6. CONTROL MEASURE ANALYSIS

6.1 Introduction

The air quality modeling performed for this project quantified the impacts at each of the monitoring sites exceeding the 24-hour PM-10 standard in the modeling domain. Separate inventories of sources within the domain were developed for each of the low wind and high wind design days, and separate modeling runs were performed for each design day. The source-specific PM-10 impacts at each monitor were aggregated by source group for use in an analysis of control strategy benefits. Control strategy benefits were estimated from analysis of each adopted control measure and overall control efficiencies resulting from implementation of all measures were calculated for individual source categories. Discussions of each of these steps and the overall results are presented in this section.

6.2 Summary of Baseline Modeling Results

The modeling analysis discussed in Section 5.6 quantified the air quality impacts of significant source category emissions at each of the Durango Complex, W. 43rd Avenue, and Bethune Elementary School monitoring sites. These impacts were also evaluated for each of the low wind and high wind design days. As discussed in Section 5.1 differences in design day conditions and the addition of a windblown soil source category for the high wind day produce substantial differences in the emission inventories for December 12, 2005, and February 15, 2006. The inventory differences were further magnified by differences in source locations (e.g., construction sites) and meteorological conditions (e.g., wind direction), which when modeled produced significant differences in source contributions.

On the low wind day, sources that were under active disturbance and close to a monitor dominated the modeled impacts. In the absence of high winds, emissions from windblown dust sources, such as disturbed vacant lots, were virtually zero. On this day, only those sources experiencing some level of anthropogenic activity, such as equipment movement at construction sites, were estimated to have substantial emissions. The presence of stagnant conditions during the low wind speed day also resulted in frequent shifts in hourly average wind direction, causing sources from many different directions to impact each monitor. Nearby sources also produced greater impacts at monitors on this day as the effects of particle settling and deposition on emissions traveling from more distant sources reduced the impacts from these latter sources. Furthermore, inversion heights were very low during most of the low wind day, causing emissions from nearby sources to remain concentrated near the ground when impacting the monitors. The modeled impacts at each of the three monitoring sites on the low wind design day, normalized to the daily average PM-10 recorded on that day at each monitor, are presented in Table V-6-1.

On the high wind design day, modeled impacts—and measured concentrations—at the three monitors were somewhat lower than impacts on the low wind day. During the high wind day, the background concentrations were more than double those of the low wind day, and the increased vertical dispersion afforded by much greater inversion heights on this day diluted the emission impacts from nearby sources. The source-specific impacts reported by high wind day modeling are presented in Table V-6-2. As these data indicate, over 50 percent of the high wind day impacts were caused by windblown dust from alluvial areas, nearby disturbed soil areas, and regional background sources. The regional background sources, as indicated by high wind day monitoring data at the regional background site, also appeared to be dominated by wind entrainment of fugitive dust from disturbed soil surfaces.

6.3 Discussion of Adopted Control Measures

The MAG Five Percent Plan for PM-10 contains 25 committed control measures that have been quantified for emission reduction credit. These measures target major portions of the PM-10 emission inventory in the nonattainment area for control. These control measures are intended to bring all monitors in the PM-10 nonattainment area, including the Salt River Area monitors, into attainment and to reduce the emission inventory by 5 percent per year between 2007 and 2010 in conformance with Clean Air Act requirements. A list of the committed control measures that have been quantified for the Five Percent Plan is presented in Table V-6-3.

The committed control measures in the plan reduce PM-10 emissions from the following sources in the PM-10 emissions inventory:

- Paved road trackout;
- Unpaved parking areas;
- Industrial sources;
- Construction activities;
- Disturbed vacant lots; and
- Biomass burning.

Not all of the committed control measures provide significant benefit to the Salt River Area. The measures that do provide benefit, and the estimated emission reduction benefits, are grouped by affected source category and further described below.

6.4 Paved Road Travel

During the past two years, the baseline silt loadings on Salt River area arterial roads have declined dramatically. The primary cause of this reduction has been the increasingly aggressive enforcement posture taken by MCAQD in enforcing compliance with Rules 310 and 316. This new posture is evidenced by the very sizeable increases in violation penalties assessed and collected by the Department.

Table V-6-1
Low Wind Design Day (Dec. 12, 2005)
Source Distribution
(µg/m³)

Source Category	Durango Complex		West 43rd Avenue		Bethune Elementary School	
	Normalized Prediction	% of Total	Normalized Prediction	% of Total	Normalized Prediction	% of Total
Freeway Traffic	6.19	3.0%	2.75	1.2%	17.92	9.1%
Arterial Traffic	58.77	28.4%	34.09	14.6%	48.36	24.4%
Secondary Traffic	7.01	3.4%	16.72	7.2%	21.05	10.6%
Arterial Trackout	22.89	11.1%	51.90	22.3%	19.90	10.1%
Secondary Trackout	2.52	1.2%	6.00	2.6%	7.55	3.8%
Arterial Shoulders	2.94	1.4%	1.14	0.5%	0.52	0.3%
Secondary Shoulders	0.10	0.0%	0.26	0.1%	0.35	0.2%
Industrial Area Sources	37.95	18.3%	60.49	25.9%	20.13	10.2%
Industrial Point Sources	2.45	1.2%	6.41	2.8%	3.85	1.9%
Vacant Lots	0.03	0.0%	0.03	0.0%	0.01	0.0%
Unpaved Parking Lots	3.87	1.9%	0.76	0.3%	1.49	0.8%
Agricultural Operations	1.68	0.8%	0.26	0.1%	0.96	0.5%
Construction Activities	19.57	9.5%	11.39	4.9%	15.01	7.6%
Local Truck Yard	0.00	0.0%	0.00	0.0%	0.00	0.0%
Ambient Background	40.90	19.8%	40.90	17.5%	40.90	20.7%
Total	206.86	100.0%	233.09	100.0%	198.00	100.0%

Table V-6-2 High Wind Design Day (Feb. 15, 2006) Modeling Summary (µg/m³)				
Source category	Durango Complex		West 43rd Avenue	
	Normalized Prediction	% of Total	Normalized Prediction	% of Total
Freeway Traffic	2.22	1.4%	0.42	0.2%
Arterial Traffic	14.53	9.2%	7.63	3.8%
Secondary Traffic	4.29	2.7%	2.44	1.2%
Arterial Trackout	5.94	3.8%	18.61	9.2%
Secondary Trackout	1.54	1.0%	0.87	0.4%
Arterial Shoulders	0.90	0.6%	0.28	0.1%
Secondary Shoulders	0.05	0.0%	0.03	0.0%
Industrial Area Sources	4.27	2.7%	13.05	6.4%
Industrial Point Sources	0.89	0.6%	1.62	0.8%
Vacant Lots	0.03	0.0%	0.00	0.0%
Unpaved Parking Lots	0.50	0.3%	0.00	0.0%
Local Truck Yard	9.04	5.7%	0.00	0.0%
Agricultural Operations	0.08	0.0%	0.12	0.1%
Construction Activities	1.67	1.1%	1.00	0.5%
Windblown Alluvial Soil	0.22	0.1%	7.25	3.6%
Windblown Soil:				
Agriculture	0.08	0.1%	0.00	0.0%
Construction	1.10	0.7%	0.66	0.3%
Industry	2.99	1.9%	31.30	15.5%
Unpaved Parking Lots	19.66	12.5%	0.09	0.0%
Vacant Lots	0.60	0.4%	20.50	10.1%
Road Shoulders	0.00	0.0%	9.32	4.6%
Background	87.01	55.2%	87.01	43.0%
Total	157.58	100.0%	202.22	100.0%

Table V-6-3 **Committed Control Measures to Reduce PM-10 Emissions**	
Number	Title
2	Extensive dust control training program
3 & 16	Dust coordinators/technicians at earthmoving sites > 5 acres
8	Conduct nighttime and weekend inspections
9	Increase consistent inspection frequency for permitted facilities
10	Increase number of proactive consistent inspections in areas of highest PM-10 emissions densities
21	Ban leaf blowers from blowing debris into street
22	Implement leaf blower outreach program
23	Ban ATV use on high pollution days
25	Pave or stabilize existing unpaved parking lots
28	Pave or stabilize unpaved shoulders
30	Strengthen/increase enforcement of Rule 310.01 for vacant lots
31&32	Restrict vehicle use on vacant lots and increase enforcement
33	Recover costs of stabilizing vacant lots
34	Increase fines for open burning
35	Restrict use of outdoor fireplaces on high pollution advisory days
36, 37, 38	Strengthen Rule 310 to promote continuous compliance
44	Maricopa County should increase consistent enforcement in the areas where PM-10 violations continue to occur, along with efforts throughout the region
45	Prohibit use of leaf blowers on unstabilized surfaces
47&48	Other burning restrictions in SB 1552
53	Repave or overlay paved roads with rubberized asphalt

Toward the end of 2005, at the onset of winter stagnant conditions that produced frequent exceedances of the federal 24-hour PM_{10} standard in the Salt River area, MCAQD was collecting $20,000 to $80,000 monthly in penalty fines. Since then, fine payment levels – both in monthly totals and in individual case totals – have climbed significantly. Toward the end of 2006, monthly fine totals varied between $300,000 and $600,000. The overall fines collected in 2006 totalled $3,700,000. The most recent tally of 2007 penalty activity shows that as of the end of October, over $4,700,000 had been collected during the ten month period. A large portion of these fines are related to prosecuted violations of Rules 310 and 316, rules that control trackout – the major source of arterial road silt loadings – from facilities in the Salt River area. These fine levels, and the violators paying the fines, are prominently displayed in Department press releases as warnings to the regulated communities throughout the nonattainment area that the Department is serious about reducing PM_{10} emissions and improving control of emission sources.[49]

This change in enforcement can be seen in the measured silt loadings on Salt River arterials. In 2003, the Arizona Department of Environmental Quality (ADEQ) collected silt measurements on a section of 43rd Avenue with varying levels of visible trackout.[50] The analysis of silt measurements in the ADEQ study indicated that a primary road with no trackout had an average silt loading of 0.3 gm/m^2. Silt measurements for this study were collected on September 29 and 30, 2003.

On August 29 and 30, 2007, staff of Applied Environmental Consultants, a subcontractor to Sierra Research, collected silt measurements on several Salt River arterial streets.[51] These silt samples were collected and analyzed using the same EPA protocol as was used by ADEQ in 2003. With the exception of one outlier, the average of these silt measurements was 0.15 gm/m^2. The single outlier, which was a section of Central Avenue between Broadway Road and Southern Avenue with detectable trackout, had a measured silt loading of 1.1 gm/m^2.

The 50 percent reduction in baseline silt loadings on Salt River arterial streets is thought to be due to the new enforcement paradigm that has been implemented since the 2005/2006 winter when PM-10 exceedances were frequent and unexpected. The increased commitment of MCAQD to prosecute violations of all applicable requirements of Rules 310 and 316, together with increases recently approved in the number of Department enforcement staff, underscores the conclusion that a 50 percent reduction in baseline silt loadings from the December 2005 design day condition will continue, if not improve, into the future. This silt loading reduction, using the AP-42 paved road emission

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[49] *http://www.maricopa.gov/aq/news.aspx*, viewed on November 30, 2007.

[50] Revised PM-10 State Implementation Plan for the Salt River Area. Technical Support Document, Appendix D, Arizona Department of Environmental Quality, September 2005.

[51] Summary of Collection and Analysis of Silt Samples from Paved Roads in Maricopa County, Applied Environmental Consultants, September 7, 2007.

equation, will result in a 36 percent reduction in paved road emissions for all vehicle weight classes.

6.5 Paved Road Trackout

Measure 9 Increase Consistent Inspection Frequency of Proactive Rule 310 and Rule 316 Inspections
Measure 10 Increase Number of Proactive Inspections in Areas of Highest PM-10 Emissions Densities
Measure 36 Require Barriers in Addition to Rule 310 Stabilization Requirements for Construction Where all Activity Has Ceased
Measure 37 Reduce the Tolerance of Trackout to 25 Feet Before Immediate Cleanup is Required
Measure 38 No Visible Emissions Across the Property Boundary
Measure 44 Increase Enforcement in the Areas Where PM-10 Violations Continue to Occur, Along With Efforts Throughout the Region

The ADEQ trackout study conducted in 2003 for the Salt River Area PM-10 Plan demonstrated continuous trackout lengths up to 2800 feet originating from a series of mineral processing operations. The SCAMPER mobile emission sampler catalogued areas of substantial trackout several hundred feet long adjacent to mineral processing operations in the Salt River Area. In July 2007, through adoption of these measures, MCAQD was authorized to increase the agency's dust inspector staff by 51 positions, or by 170 percent. This significant increase in enforcement staff will reduce trackout noncompliance dramatically, especially given the new emphasis on attaining the 24-hour PM-10 standard by 2010. Enforcement of trackout requirements is aided by the facts that trackout is readily visible on roadway surfaces and that this evidence is long-term, meaning that it can be detected whenever an inspector drives by a facility.

Measure 37 reduces the tolerance of trackout to 25 feet before immediate cleanup is required. Other committed control measures in Table V-6-3 do not directly target paved road trackout emissions. Many, however, propose to regulate activities that contribute to trackout, including dust management at construction sites, paving of unpaved parking lots, and increased enforcement of trespass ordinances, among others. (You may want to identify these additional measures from Table V-6-3 for construction, unpaved parking lots and vacant lots here, in order to provide support the last sentence and your 80 percent reduction.)

Paved road trackout results from traffic movement over any unpaved surface onto a paved surface. A comparison of Tables II-2 and III-2 earlier in this TSD indicates that paved road emissions are reduced by 4.5 percent in the PM-10 nonattainment area by 2010. The reduction in paved road emissions is due to Measure 28 that will reduce trackout by stabilizing or paving unpaved shoulders. This is a conservative estimate, because reductions in trackout are also expected to occur with the expanded enforcement of existing and new, more stringent (e.g. Measure 37) MCAQD regulations. Currently, MCAQD Rule 310 requires the immediate removal of trackout extending over 50 feet onto a public paved road from a dust-generating operation, and Regulation 316 requires immediate removal of trackout extending more than 25 feet from any mineral processing operation.

As a result of the new emphasis on and increased resources dedicated to enforcement of MCAQD rules, Sierra estimates that trackout emissions from paved road travel in the Salt River Area will be reduced by 80 percent.

6.6 Unpaved Shoulders

Measure 28 – Pave or Stabilize Unpaved Shoulders

Although the emission reductions quantified for this measure in Chapter III were limited to the benefit of reducing trackout onto paved roads, unpaved shoulders also contribute to PM-10 emissions through truck bow wake entrainment of loose particles and through vehicle travel over unprotected soil surfaces. The reductions in truck bow wake emissions were not included in the analysis of emission benefits in Chapter III. In the Salt River Area the City of Phoenix has committed to pave 14.5 miles of the 17.3 miles of unpaved shoulders on arterial roadways by 2010. On the basis of this information, Sierra assumed that implementation of this commitment will reduce PM-10 emissions from unpaved shoulders by 83.8 percent.

6.7 Industrial Area Sources

Measure 8 Conduct Nighttime and Weekend Inspections
Measure 9 Increase Consistent Inspection Frequency for Permitted Facilities
Measure 10 Increase Number of Proactive Inspections in Areas of Highest PM-10 Emissions Densities
Measure 16 Require Dust Coordinator at Earthmoving Sites of 5-50 Acres
Measure 44 Increase Enforcement in the Areas Where PM-10 Violations Continue to Occur, Along With Efforts Throughout the Region

Under these combined measures, the frequency of inspection of industrial sites would increase. For mineral processing plants, inspections would increase from four to five per year, at a minimum. In areas of high PM-10 emission densities, more frequent inspections would be conducted by a substantially expanded number of inspectors. During 2008, MCAQD would hire an additional 51 enforcement inspectors and accompanying support personnel to implement these measures, expanding the enforcement staff to 270 percent of existing levels. Chapter III estimates that implementation of these measure will reduce emissions at industrial facilities subject to MCAQD Rule 316 by 46 percent by 2010. Rule 310 benefits, which also apply to industrial source emissions are estimated to be 48 percent. When combined these rules are estimated to reduce industrial emissions by 47 percent.

6.8 Industrial Point Sources

Emissions from permitted sources at mineral processing plants will also be further regulated by the increase in enforcement activity resulting from implementation of Measure, 8, 9, 10, and 44. As with area sources, Chapter III indicates that the committed control measures will reduce emissions from industrial point sources subject to Rule 316 by 46 percent by 2010. Rule 310 benefits, which also apply to industrial source emissions are estimated to be 48 percent. When combined these rules are estimated to reduce industrial emissions by 47 percent.

6.9 Unpaved Parking Lots – Travel Emissions

Measure 8 Conduct Nighttime and Weekend Inspections
Measure 25 Pave or Stabilize Existing Unpaved Parking Lots

Vehicle use on unpaved parking lots generates emissions in the same manner as does vehicle travel over unpaved roads. Maricopa County commitments to implement Measures 8 and 25 will increase compliance with MCAQD Rule 310.01 requirements for unpaved parking lots. In addition, Senate Bill 1552 imposes new requirements on unpaved parking lots in Area A. On residential parcels of less than 5 units having parking, maneuvering, and ingress/egress areas greater than 3,000 square feet or more, the bill requires paving or stabilization. Chapter III estimates that these measures collectively will reduce emissions from travel on unpaved parking lots by 14 percent by 2010. These reductions also apply to travel emissions from vacant lots.

6.10 Vacant Lots – Windblown Emissions

Measure 8 Conduct Nighttime and Weekend Inspections
Measure 30 Strengthen and Increase Enforcement of Rule 310.01 for Vacant Lots
Measure 31 Restrict Vehicular Use and Parking on Vacant Lots
Measure 32 Enhanced Enforcement of Trespass Ordinances and Codes
Measure 33 Recover Costs of Stabilizing Vacant Lots

The increase in enforcement staff approved for MCAQD will increase enforcement of Rule 310.01 as applicable to vacant lots. Rule 310.01 requires that vacant lots be stabilized to minimize emissions of windblown dust. The ability to recover costs of stabilization will allow Maricopa County to stabilize vacant lots as needed with guarantees of cost recovery. In addition, SB 1552 requires cities and towns in Area A to adopt or amend codes/ordinances to restrict vehicle parking and use on unpaved or unstabilized vacant lots by March 31, 2008. Due to the implementation of these measures, Chapter III estimates that windblown emissions from vacant lots will be reduced by 26 percent by 2010. These reductions also apply to windblown emissions from unpaved parking lots.

6.11 Local Truck Yard – Travel Emissions

Measure 25 – Pave or Stabilize Existing Unpaved Parking Lots

The local truck yard that is immediately east of the Durango Complex monitor will be impacted by the implementation of this measure. As with other unpaved parking lots, it is estimated that the implementation of this measure will reduce travel emissions on this parcel by 14 percent.

6.12 Local Truck Yard – Windblown Emissions

Measure 25 – Pave or Stabilize Existing Unpaved Parking Lots – Strengthen Enforcement

The increased enforcement of soil stabilization requirements under Rule 310.01 will also reduce windblown emissions from the local truck yard near the Durango Complex monitor. As with other vacant windblown dust emissions, it is estimated that implementation of this measure will reduce emissions from this parcel by 26 percent by 2010.

6.13 Agricultural Operations

The baseline December 2005 and February 2006 emission estimates, taken from the ADEQ Salt River Area TSD, include a 7.9 percent reduction in tilling emissions from the "Combining Tractor Operations" agricultural best management practice (BMP). Since additional BMPs are categorized as contingency measures in the Five Percent Plan, no additional credit can be claimed for them. Additional reductions in agricultural emissions, however, can be claimed between 2005 and 2010 using an estimate of the annual attrition in cropland that was developed in the Technical Support Document for BMPs.[52] Section 4 noted the percentage of agricultural land going out of production by 2006 was 36 percent (i.e. over a 7-year period). The annualized rate of retirement is therefore 4.6 percent. Assuming that this trend remains the same between 2005 and 2010, it would mean that an additional 25 percent of cropland would be lost. Since emissions are directly proportional to acreage, all estimates of agricultural emissions in 2010 were reduced by 25 percent. This reduction applies under both low and high wind conditions.

An additional reduction of 9.3 percent could be claimed from the "Limited Activity During High Wind Events" BMP, which is already in place (i.e., it is not a new control measure). However, given the limited incremental increase above the low wind credit, which is incorporated into the baseline emission estimate and the small contribution of agricultural emissions during high wind conditions, no additional credit for this measure was claimed.

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[52] Technical Support Document for Quantification of Agricultural Best Management Practices, Final, Prepared for Arizona Department of Environmental Quality by URS Corporation and Eastern Research Group, June 2001.

6.14 Construction Activities

Measure 2	Extensive Dust Control Training Program
Measure 3	Dust Managers at Construction Sites of 50+ Acres
Measure 8	Conduct Nighttime and Weekend Inspections
Measure 9	Increase Consistent Inspection Frequency for Permitted Facilities
Measure 10	Increase Number of Proactive Inspections in Areas of Highest PM-10 Emissions Densities
Measure 16	Dust Coordinators at Construction Sites of 5-50 Acres
Measure 36	Require Barriers in Addition to Rule 310 Stabilization Requirements for Construction Where All Activity Has Ceased
Measure 37	Reduce the Tolerance of Trackout to 25 Feet Before Immediate Cleanup is Required
Measure 38	No Visible Emissions Across the Property Boundary
Measure 44	Increase Enforcement in the Areas Where PM-10 Violations Continue to Occur, Along With Efforts Throughout the Region

Under these combined measures, dust control requirements and enforcement activity levels at construction sites will increase. Dust managers and coordinators will be required at all sites larger than 5 acres. Vehicle barriers will be required to protect inactive stabilized areas from disturbance, and trackout will be cleaned at more frequent intervals or avoided altogether. During 2008, MCAQD would hire an additional 51 enforcement inspectors and accompanying support personnel to implement these measures, expanding the enforcement staff to 270 percent of existing levels. Chapter III estimates that implementation of these measures will reduce emissions at construction sites by 48 percent by 2010 on both low wind and high wind days.

6.15 Background – Low Wind Conditions

Earlier analysis of transport into the modeling domain determined that under low wind conditions the mean background level is 40.9 $\mu g/m^3$ with a 78 percent/22 percent split between anthropogenic and non-anthropogenic contributions, as described in Section 5. The first step in quantifying changes in background concentrations between 2005 and 2010 was to quantify the non-anthropogenic component and assume that it remains unchanged over time. The next step was to determine the share of background that is PM-2.5. Data collected at the West Phoenix monitor on December 12, 2005 indicates that share to be 33.1 percent. Applying this value to the total background level produces a PM-2.5 concentration of 13.5 $\mu g/m^3$. The next step was to determine those portions that are formed as secondary particulate and to forecast the change in their concentrations expected between 2005 and 2010.

A review of the literature shows that ammonia exists mainly in the form of ammonium nitrate and ammonium sulfate (or ammonium bisulfate if the pH is low) in the particle phase in a size range that is less than or equal to PM-2.5. A recent analysis[53] of fine particulate matter in Phoenix showed the average composition of PM-2.5 in the winter to be 6 percent ammonium sulfate and 21 percent ammonium nitrate. That analysis used data collected at IMPROVE monitoring sites in Phoenix between April 2001 and October 2003. These values were applied to the PM-2.5 component of background, 13.5 $\mu g/m^3$, to determine the 2005 baseline values of ammonium sulfate and ammonium nitrate. The baseline values were then forecast to 2010 based on changes in NOx and SOx inventories by 2010 in the nonattainment area.

The method used to develop this forecast was to subdivide the 2005 NOx and SOx nonattainment area inventory into mobile source and non-mobile sources. MAG provided forecasts of the mobile source NOx and SOx inventories in 2010 for the nonattainment area. These values included the effects of both growth (i.e., increases in travel activity) and control (e.g., the effects of fleet turnover predicted by MOBILE6, etc.). No similar forecasts for the non-mobile source categories were available so they were increased in proportion to the 15 percent in growth population projected for the nonattainment area between 2005 and 2010 (i.e., no benefits of control were included). After accounting for the effects of growth and control on both mobile and non-mobile sources, NOx emissions in the nonattainment area are projected to decline by 9.1 percent between 2005 and 2010.

This reduction, however, must be considered in light of the projected change in ammonia emissions. Since ammonia present in the atmosphere first forms ammonium sulfate and any residual ammonia is then available for the formation of ammonium nitrate, the change in ammonia emissions will control the formation of ammonium nitrate. A review of the MCAQD's 2005 inventory shows that vehicles account for less than 15 percent of NH_3 emissions while livestock accounts for almost 50 percent. Since no forecast of ammonia emissions in the nonattainment area is available, it is useful to examine trends in the key source categories. While vehicle-related ammonia will increase in proportion to changes in travel, the overall change in the inventory will be quite small. Livestock-related ammonia in recent years has declined as dairies have moved out of the area in response to pressure from development. Given the recent economic downturn, this pressure may ease. Nevertheless dairy-related ammonia is not expected to increase. The net between these two trends is a stable outlook for ammonia. If this is true, then the reductions in NOx will not produce a reduction in ammonium nitrate, because ammonia, the controlling pollutant, will remain unchanged. To be conservative, it is assumed that ammonium nitrate emissions will not change between 2005 and 2010.

A similar set of calculations were also prepared to quantify the changes in SOx emissions and the reductions between 2005 and 2010 for ammonium sulfate concentrations. These calculations are also summarized in Table V-6-4. As can be seen, mobile source SOx emissions are projected to decline substantially (after accounting for the effects of both

[53] Source Apportionment of Fine Particulate Matter in Phoenix, AZ Using Positive Matrix Factorization, Steven Brown, et al, Journal of Air Waste Management Association Volume 57, June 2007.

growth and control), while the non-mobile source emissions were projected to increase in proportion to the projected population growth. The result is that nonattainment area SOx emissions are projected to decline by 24.4 percent between 2005 and 2010. Since ammonia present in the atmosphere preferentially forms ammonium sulfate, no adjustments were applied to the estimated reduction in SOx emissions.

Table V-6-4
Forecasts of Change in Ammonium Nitrate and Ammonium Sulfate Between 2005 and 2010
(tons/year)

Source Category	2005	Growth & Control	2010
Ammonium Nitrate			
Mobile Source NOx	63,093.0	0.76	48,096.0
All Other NOx	38,265.9	1.15	44,005.8
Total	101,358.9	0.91	92,101.8
2005 - 2010 NOx Reduction			9.1%
2005 – 2010 NH_3 Reduction			No change
2005 – 2010 Ammonium Nitrate Reduction			0%
Ammonium Sulfate			
Mobile Source SOx	1,536.0	0.29	452.4
All Other SOx	1,797.8	1.15	2,067.5
Total	3,333.8	0.65	2,519.9
2005 – 2010 SOx Reduction			24.4%

The change in NOx and SOx emissions calculated between 2005 and 2010 were applied to the estimated 2005 ammonium nitrate and ammonium sulfate concentrations to project the 2010 concentrations. The two remaining categories of background, non-ammonium PM-2.5 and PM-2.5–PM-10 portion of anthropogenic background were then projected to grow from 2005 to 2010 in proportion to the growth in uncontrolled PM-10 emissions forecast for the nonattainment area. The forecasted 2010 values were then reduced to account for the benefits of implementing the committed control measures in the PM-10 nonattainment area. When the results of each background category are combined, the concentration forecasted for 2010 is estimated to be reduced to 38.9 $\mu g/m^3$, which represents a reduction of 14.4 percent relative to the uncontrolled value in 2010. A summary of these calculations is presented in Table V-6-5.

Table V-6-5 Calculation of Change in Low Wind Background Between 2005 and 2010 ($\mu g/m^3$)						
Category	Share	2005	Growth	Uncontrolled 2010	Control	Controlled 2010
Background	1.00	40.9	-	-	-	-
Anthropogenic	0.78	32.1	-	-	-	-
Non-anthropogenic	0.22	8.8	-	8.8	-	8.8
PM-2.5	0.33	13.5	-	-	-	-
Ammonium Nitrate	0.21	2.8	-	2.8	-	2.8
Ammonium Sulfate	0.06	0.8	-	0.8	24.4%	0.6
Remaining PM-2.5	0.73	9.9	16.1%	11.5	19.3%	9.3
Remaining Anthropogenic		18.5	16.1%	21.5	19.3%	17.3
Total		40.9	-	45.5	-	38.9

6.16 Background – High Wind Conditions

The analysis of transport into the modeling domain under high wind conditions determined the mean 24-hour average background level to be 87.0 $\mu g/m^3$ on February 15, 2006, with a 74 percent/26 percent split between anthropogenic and non-anthropogenic sources, as described in Section 5. The method used to estimate the high wind concentration divided February 15, 2006 into three different periods and used the low wind values to represent the morning concentrations and measurements at Buckeye to represent the high wind portion of the afternoon separately from night time hours. The Organ Pipe values used to represent non-anthropogenic background were based on filter measurements and therefore only provide a 24-hour estimate of that component of background. Thus, no information is available to split that estimate into portions of the day that comport with those used to estimate background impacting the Salt River Area. For this reason, the method used to calculate the change in background between 2005 and 2010 was to simply break out the anthropogenic and non-anthropogenic components. The anthropogenic component was then increased to account for growth in the PM-10 inventory forecast for the nonattainment area and reduced to account for the new controls applied in 2010. The nonathropogenic component was assumed to remain unchanged between 2005 and 2010. A summary of the calculations is presented in Table V-6-6. It shows that high wind background is projected to decline from the uncontrolled value of 97.4 $\mu g/m^3$ in 2010 to 82.9 $\mu g/m^3$ in 2010, which represents a reduction of 14.9 percent.

Table V-6-6 Calculation of Change in High Wind Background Between 2005 and 2010 ($\mu g/m^3$)						
Category	Share	2005	Growth	Uncontrolled 2010	Control	Controlled 2010
Background	1.00	87.0	-	-	-	-
Anthropogenic	0.74	64.7	16.1%	75.0	19.3%	60.6
Non-anthropogenic	0.26	22.4	-	22.4	-	22.4
Total		87.0	-	97.4	-	82.9

6.17 Summary

A listing of the PM-10 emission inventory produced for each of the previously described source categories in the Salt River Area is presented in Table V-6-7.

Table V-6-7
Summary of Source Specific PM-10 Control Measure Reductions
for
Salt River Area Modeling Domain And Design Day Conditions
In 2010

Source Category	Low Wind	High Wind
Freeway Traffic	0%	0%
Arterial Traffic	36%	36%
Secondary Traffic	36%	36%
Arterial Trackout	80%	80%
Secondary Trackout	80%	80%
Arterial Shoulders	84%	84%
Secondary Shoulders	0%	0%
Industrial Area	47%	47%
Industrial Point	47%	47%
Vacant Lots	14%	14%
Unpaved Parking Lots	14%	14%
Local Truck Yard	14%	14%
Agricultural Operations	25%	25%
Construction Activities	48%	48%
Windblown Alluvial Soil	-	0%
Windblown Soil:		
Agriculture	-	25%
Construction	-	48%
Industry	-	47%
Unpaved Parking Lots	-	26%
Vacant Lots	-	26%
Road Shoulders	-	84%
Background	14%	15%

7. DEMONSTRATION OF ATTAINMENT

Assessing the impact of the control strategies on concentrations within the Salt River Area modeling domain in 2010 requires the integration of data developed in previous sections of this chapter. First, the normalized concentrations produced in Section 5.6 for the design days must be adjusted to account for expected growth between 2005/2006 and 2010. These values must then be adjusted for the benefits of new control measures that will be fully implemented in 2010, as discussed in Section 6. Each of these calculations must be performed separately for the selected monitoring locations, design days and source category. The resulting concentrations in 2010 must then be summed and contrasted with the 24-hour PM-10 standard of 150 $\mu g/m^3$ to determine if attainment has been demonstrated. A similar analysis of the impact of control measures on emission inventories is required to quantify the tonnage reductions in the Salt River Area modeling domain needed to demonstrate attainment. Presented below is a description and summary of the results of these calculations.

7.1 Growth and Control Factors

The normalized source-specific emission concentrations produced in Section 5.6 are valid for the years in which the exccedances occurred (i.e., 2005 and 2006); however, they do not represent the concentrations that would be produced in 2010 under the same conditions. The individual source-specific estimates must first be adjusted to account for the expected growth that will occur within the modeling domain. Presented below is a summary of assumptions used to make those projections for each source category:

- *Paved Road Sources* – MAG prepared an analysis of the growth in travel in the Salt River Area which showed that travel between 2007 and 2010 is expected to increase from 1,922,023 to 2,126,426 miles/day. The aggregate increase of 10.6 percent is equivalent to 3.4 percent on an annualized basis. This annualized increase was extrapolated for a five-year period to represent the difference between 2005 and 2010 and produced an aggregate growth estimate of 18.2 percent. This value was applied to all paved road-related concentrations (e.g., freeway traffic, arterial trackout, secondary shoulders, etc.) in 2005 to produce an estimate of the concentrations that would occur in 2010 without the benefit of any additional controls. The same factor was applied to both low and high wind sources (i.e., no distinction was made between growth from December 2005 and February 2006).

- *Industrial Sources* – In contrast to travel, no growth factor was applied to the 2005 industrial point and area source concentrations. The reason is based on discussions with aggregate producers who stated that 2005 represented a peak year in terms of both residential, commercial and road construction. A review of permits issued between 2000 and 2006 confirmed that 2005 was a peak year for construction activity in both Phoenix and Maricopa County (see the construction discussion below for the appropriate reference). In light of the decline in activity reported for 2006 and indications of steeper declines in 2007, it is unlikely that the 2005 values will be achieved in the near term. For this reason, it is conservative to use the 2005 industrial concentrations to represent levels expected in 2010.

- *Vacant Lots* – The Salt River Area TSD referenced a 2004 survey of vacant lots in the Salt River Area which indicated a "39% decrease in area from conversion to residential or commercial buildings." Despite the trend in declining vacant land area, the 2005 values were conservatively assumed to represent concentrations expected in 2010.

- *Unpaved Parking Lots* – No information on trends in unpaved parking lot acreage could be identified. It is believed, however, that the same development trends affecting vacant lot and agricultural acreage are also affecting unpaved parking lot acreage. To be conservative, the 2005 values were left unchanged to represent concentrations in 2010.

- *Agricultural Operations* – As discussed in Section 6, agricultural land within Maricopa County has been documented as going out of production at the rate of 4.6 percent per year. Given the decline in land area over time, there is no reason to project that any growth in either emissions or concentrations from this source will occur between 2005 and 2010.

- *Construction* – The modeled concentrations for low wind conditions in December 2005 and high wind conditions in February 2006 were not adjusted for growth in construction to represent values in 2010. The principal reason for not increasing construction activity between 2005 and 2010 is because a review of historical data showed that construction activity in Phoenix and Maricopa County in 2005 was at a historical peak[54] (in terms of number of permits issued and total dollars of construction). In light of the decline in activity reported for 2006 and indications of steeper declines in 2007, it is unlikely that the 2005 values will be achieved in the near term. For this reason, it is conservative to use 2005 permits and emissions to represent construction emissions in 2010.

- *Windblown* – The modeled concentrations for the design day in 2006 were left unchanged to represent 2010. For reasons noted above, this approach is assumed to produce a conservative forecast of concentrations in 2010.

- *Background* – As described in Section 6, background values for both low and high wind conditions were divided into their anthropogenic and non-anthropogenic components. For the low wind values, MAG provided estimates of mobile source emissions in 2010 that combined the effects of growth and control. These values

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[54] *http://www.poly.asu.edu/realty/market_update.html*

were used to quantify changes in secondary particulate formation. Since estimates for these background particles do not separately address growth and control, only summary values for low wind background are presented in 2010. The high wind background estimates did not address the impact of secondary particle formation; therefore separate estimates of uncontrolled and controlled background in 2010 are presented.

A summary of the impact of the above growth assumptions on 2010 predicted concentrations is presented in Tables V-7-1 through V-7-7. Each table chronicles the impact of growth and control assumptions on projected concentrations by source category for each of the monitors and design days. As can be seen in Table V-7-1, the net effect of the growth assumptions is to increase the 2005 design value for the Durango Complex under December 12, 2005 low wind conditions from 206.9 $\mu g/m^3$ to 229.5 $\mu g/m^3$ in 2010; this represents an overall increase of 10.9 percent. The impact of the growth assumptions vary because of changes in the distribution of source contributions between monitors and design days. The application of these growth factors does not account for the benefits of any new control measures. This approach assumes that the predicted 2010 values represent concentrations that would occur with the mix of control measures in place in 2005.

The final step in the analysis is to apply the control factors described in Section 6 to the projected 2010 concentrations. Each table lists the control factors applied to each source category and displays the concentration that results. There are considerable differences in the benefits claimed in 2010. These reductions, however, are not just the result of control measures. They also reflect trends in land development patterns (e.g., the shift of agricultural acreage to other uses, etc.) and changes observed in factors that determine emissions (e.g., reductions in silt loadings on arterial and local roads within the Salt River Area). Collectively the impact of these controls is sufficient to demonstrate that each monitor and design day in 2010 will have concentrations that fall below the 24-hour PM-10 standard of 150 $\mu g/m^3$. This indicates that attainment has been demonstrated under all conditions at all monitoring locations recording exceedances within the modeling domain.

7.2 Emission Reductions

A separate, but parallel, set of calculations was prepared to document the change in the emission inventory that will result from the application of growth and control factors. A listing of these calculations for each monitor and design day is presented in Appendix V, Exhibit 1. Table V-7-8 provides a summary of the tonnage reductions by source category for the low wind days for each monitor. A similar summary for the high wind days is presented in Table V-7-9. It should be noted that no estimates of the tonnage reductions are available for windblown sources. This is because wind speed is an input to AERMOD and it internally calculates the tons of emissions produced from each of the windblown source categories. No tonnage values are produced, only the resulting source specific concentrations are provided. Without an estimate of the original tons estimated for these sources, it is not possible to calculate an estimate of the reductions produced by the applicable control measures.

Table V-7-1
2010 Attainment Demonstration
Low Wind Design Day (Dec. 12, 2005) Durango Complex
(μg/m³)

Source Category	2005 Normalized	2010 Prediction	Control Factor	2010 Controlled
Freeway Traffic	6.19	7.30	0%	7.30
Arterial Traffic	58.77	69.35	36%	44.19
Secondary Traffic	7.01	8.27	36%	5.27
Arterial Trackout	22.89	27.01	80%	5.40
Secondary Trackout	2.52	2.97	80%	0.59
Arterial Shoulders	2.94	3.46	84%	0.55
Secondary Shoulders	0.10	0.12	0%	0.12
Industrial Area	37.95	37.96	47%	20.19
Industrial Point	2.45	2.45	47%	1.30
Vacant Lots	0.03	0.03	14%	0.02
Unpaved Parking Lots	3.87	3.87	14%	3.32
Agricultural Operations	1.68	1.68	25%	1.25
Construction Activities	19.57	19.57	48%	10.13
Local Truck Yard	0.00	0.00	14%	0.00
Background	40.90	45.47	14%	38.90
Total	206.86	229.50		138.57

Table V-7-2 2010 Attainment Demonstration Low Wind Design Day (Dec. 12, 2005) West 43rd Avenue (µg/m^3)				
Source Category	2005 Normalized	2010 Prediction	Control Factor	2010 Controlled
Freeway Traffic	2.75	3.25	0%	3.25
Arterial Traffic	34.09	40.22	36%	25.63
Secondary Traffic	16.72	19.73	36%	12.57
Arterial Trackout	51.90	61.24	80%	12.25
Secondary Trackout	6.00	7.08	80%	1.42
Arterial Shoulders	1.14	1.34	84%	0.21
Secondary Shoulders	0.26	0.31	0%	0.31
Industrial Area	60.49	60.50	47%	32.18
Industrial Point	6.41	6.41	47%	3.41
Vacant Lots	0.03	0.03	14%	0.03
Unpaved Parking Lots	0.76	0.76	14%	0.65
Agricultural Operations	0.26	0.26	25%	0.20
Construction Activities	11.39	11.39	48%	5.89
Local Truck Yard	0.00	0.00	14%	0.00
Background	40.90	45.47	14%	38.90
Total	233.09	257.97		136.90

Table V-7-3 2010 Attainment Demonstration Low Wind Design Day (Dec. 12, 2005) Bethune Elementary School ($\mu g/m^3$)				
Source Category	2005 Normalized	2010 Prediction	Control Factor	2010 Controlled
Freeway Traffic	17.92	21.15	0%	21.15
Arterial Traffic	48.36	57.07	36%	36.37
Secondary Traffic	21.05	24.84	36%	15.83
Arterial Trackout	19.90	23.49	80%	4.70
Secondary Trackout	7.55	8.91	80%	1.78
Arterial Shoulders	0.52	0.61	84%	0.10
Secondary Shoulders	0.35	0.42	0%	0.42
Industrial Area	20.13	20.13	47%	10.71
Industrial Point	3.85	3.85	47%	2.05
Vacant Lots	0.01	0.01	14%	0.01
Unpaved Parking Lots	1.49	1.49	14%	1.28
Agricultural Operations	0.96	0.96	25%	0.72
Construction Activities	15.01	15.01	48%	7.77
Local Truck Yard	0.00	0.00	14%	0.00
Background	40.90	45.47	14%	38.90
Total	198.00	223.38		141.77

Table V-7-4
2010 Attainment Demonstration
Low Wind Design Day (Dec. 13, 2005) Durango Complex
(µg/m^3)

Source Category	2005 Normalized	2010 Prediction	Control Factor	2010 Controlled
Freeway Traffic	4.31	5.08	0%	5.08
Arterial Traffic	51.98	61.34	36%	39.09
Secondary Traffic	7.11	8.38	36%	5.34
Arterial Trackout	20.37	24.04	80%	4.81
Secondary Trackout	2.55	3.01	80%	0.60
Arterial Shoulders	2.63	3.10	84%	0.50
Secondary Shoulders	0.10	0.12	0%	0.12
Industrial Area	20.81	20.81	47%	11.08
Industrial Point	2.37	2.37	47%	1.26
Vacant Lots	0.00	0.00	14%	0.00
Unpaved Parking Lots	1.31	1.31	14%	1.13
Agricultural Operations	1.22	1.22	25%	0.91
Construction Activities	10.40	10.40	48%	5.38
Local Truck Yard	0.00	0.00	14%	0.00
Background	40.90	45.47	14%	38.90
Total	166.07	186.67		114.21

Table V-7-5 2010 Attainment Demonstration Low Wind Design Day (Dec. 13, 2005) West 43rd Avenue ($\mu g/m^3$)				
Source Category	2005 Normalized	2010 Prediction	Control Factor	2010 Controlled
Freeway Traffic	0.94	1.11	0%	1.11
Arterial Traffic	19.34	22.82	36%	14.54
Secondary Traffic	5.67	6.70	36%	4.27
Arterial Trackout	44.27	52.24	80%	10.45
Secondary Trackout	2.04	2.40	80%	0.48
Arterial Shoulders	0.64	0.76	84%	0.12
Secondary Shoulders	0.08	0.09	0%	0.09
Industrial Area	48.72	48.72	47%	25.92
Industrial Point	2.75	2.75	47%	1.47
Vacant Lots	0.00	0.00	14%	0.00
Unpaved Parking Lots	0.05	0.05	14%	0.04
Agricultural Operations	0.14	0.14	25%	0.10
Construction Activities	2.17	2.17	48%	1.12
Local Truck Yard	0.00	0.00	14%	0.00
Background	40.90	45.47	14%	38.90
Total	167.72	185.42		98.62

Table V-7-6 2010 Attainment Demonstration High Wind Design Day (Feb. 15, 2006) Durango Complex (μg/m^3)				
Source Category	2005 Normalized	2010 Prediction	Control Factor	2010 Controlled
Freeway Traffic	2.22	2.63	0%	2.63
Arterial Traffic	14.53	17.19	36%	10.96
Secondary Traffic	4.29	5.07	36%	3.23
Arterial Trackout	5.94	7.02	80%	1.40
Secondary Trackout	1.54	1.82	80%	0.36
Arterial Shoulders	0.90	1.06	84%	0.17
Secondary Shoulders	0.05	0.06	0%	0.06
Industrial Area	4.27	4.27	47%	2.27
Industrial Point	0.89	0.89	47%	0.47
Vacant Lots	0.03	0.03	14%	0.02
Unpaved Parking Lots	0.50	0.50	14%	0.43
Agricultural Operations	0.08	0.08	25%	0.06
Construction Activities	1.67	1.67	48%	0.87
Local Truck Yard	9.04	9.04	14%	7.76
Windblown Soil				
Agriculture	0.08	0.08	25%	0.06
Construction	1.10	1.10	48%	0.57
Industry	2.99	2.99	47%	1.59
Unpaved Parking Lots	19.66	19.66	26%	14.54
Vacant Lots	0.60	0.60	26%	0.44
Road Shoulders	0.00	0.00	84%	0.00
Alluvial	0.22	0.22	0%	0.22
Background	87.01	97.39	15%	82.91
Total	157.58	173.35		131.02

Table V-7-7 2010 Attainment Demonstration High Wind Design Day (Feb. 15, 2006) West 43rd Avenue (µg/m³)				
Source Category	2005 Normalized	2010 Prediction	Control Factor	2010 Controlled
Freeway Traffic	0.42	0.50	0%	0.50
Arterial Traffic	7.63	9.02	36%	5.75
Secondary Traffic	2.44	2.89	36%	1.84
Arterial Trackout	18.61	22.02	80%	4.40
Secondary Trackout	0.87	1.04	80%	0.21
Arterial Shoulders	0.28	0.33	84%	0.05
Secondary Shoulders	0.03	0.04	0%	0.04
Industrial Area	13.05	13.05	47%	6.91
Industrial Point	1.62	1.62	47%	0.86
Vacant Lots	0.00	0.00	14%	0.00
Unpaved Parking Lots	0.00	0.00	14%	0.00
Agricultural Operations	0.12	0.12	25%	0.09
Construction Activities	1.00	1.00	48%	0.52
Local Truck Yard	0.00	0.00	14%	0.00
Windblown Soil				
Agriculture	0.00	0.00	25%	0.00
Construction	0.66	0.66	48%	0.34
Industry	31.30	31.30	47%	16.65
Unpaved Parking Lots	0.09	0.09	26%	0.07
Vacant Lots	20.50	20.50	26%	15.16
Road Shoulders	9.32	9.32	84%	1.49
Alluvial	7.25	7.25	0%	7.25
Background	87.01	97.39	15%	82.91
Total	202.22	218.15		145.08

It should be noted when reviewing these reductions that the base 2005 Salt River emission estimates for many of the source categories are identical for all of the design days, both low and high wind, (e.g., traffic, trackout, shoulders, etc.). As noted in Table V-5-1, however, emission estimates for some of the other sources vary between low and high wind conditions (e.g., construction, windblown soil, etc.). The inventories for each design day incorporating these differences were then normalized to reflect the changes needed to replicate the shifts in source-specific concentrations needed to match the design day concentrations. Each resulting monitor, day and source-specific inventory was then forecast to 2010 using the growth factors described above and control measure reductions described in Section 6. The reductions presented in Tables V-7-8 and V-7-9 reflect the difference between the projected and controlled 2010 inventories. The tables show that a consistent pattern of reductions can demonstrate attainment under all conditions.

When reviewing Table V-7-9 ,it should be noted that for reasons described earlier, the tons reduced only reflect non-windblown emissions. The tonnage reductions for windblown emissions have not been calculated, but are expected to be significant.

Table V-7-8
Summary of Salt River Modeling Domain Emission Reductions Required to Demonstrate Attainment Under Low Wind Conditions for Each Monitor and Design Day
(tons/day)

	Durango Complex		West 43rd Avenue		Bethune
Source Category	12/12/05	12/13/06	12/12/05	12/13/06	12/12/05
Freeway Traffic	0.00	0.00	0.00	0.00	0.00
Arterial Traffic	2.59	3.34	3.87	3.80	2.41
Secondary Traffic	1.16	1.47	1.58	1.67	1.05
Arterial Trackout	2.48	3.19	3.81	3.72	2.30
Secondary Trackout	0.93	1.17	1.26	1.33	0.84
Arterial Shoulders	0.10	0.13	0.15	0.15	0.09
Secondary Shoulders	0.00	0.00	0.00	0.00	0.00
Industrial Area	1.50	1.87	2.19	2.04	1.40
Industrial Point	0.34	0.47	0.52	0.52	0.31
Vacant Lots	0.01	0.01	0.01	0.01	0.01
Unpaved Parking Lots	0.01	0.01	0.01	0.01	0.01
Agricultural Operations	0.03	0.04	0.04	0.05	0.03
Construction Activities	1.13	1.50	1.58	1.77	1.05
Local Truck Yard	0.00	0.01	0.00	0.01	0.00
Total	10.26	13.21	15.01	15.07	9.50

Table V-7-9 **Summary of Salt River Modeling Domain Emission Reductions Required to Demonstrate Attainment Under High Wind Conditions for Each Monitor and Design Day** **(tons/day)**		
Source Category	Durango Complex	West 43rd Avenue
	February 15, 2006	
Freeway Traffic	0.00	0.00
Arterial Traffic	2.36	3.31
Secondary Traffic	1.01	1.50
Arterial Trackout	2.25	3.26
Secondary Trackout	0.81	1.20
Arterial Shoulders	0.09	0.12
Secondary Shoulders	0.00	0.00
Industrial Area	1.41	1.80
Industrial Point	0.30	0.42
Vacant Lots	0.01	0.01
Unpaved Parking Lots	0.01	0.01
Agricultural Operations	0.03	0.05
Construction Activities	1.20	1.91
Local Truck Yard	0.00	0.00
Total	9.48	13.59

VI. HIGLEY AREA MODELING

The purpose of this modeling was to develop a micro-scale emissions inventory, identify major PM-10 sources, and perform an attainment demonstration using the rollback model for the area surrounding the Higley monitoring station. The Higley monitoring station was selected because it has the highest PM-10 readings in the PM-10 nonattainment area outside of the Salt River Study Area. As the only 24-hour PM-10 exceedance day observed in 2005 and 2006 at the Higley monitoring station, January 24, 2006 was selected as the design day for the proportional rollback modeling. The background PM-10 concentration on the design day was evaluated by T&B Systems (T&B Systems, 2007) and the details are described in Appendix VI, Exhibit 1. The design day and the corresponding PM-10 and background concentrations at the Higley monitoring station are identified in Table VI-1.

Table VI-1. Design day and background 24-hour PM-10 concentration.

Monitoring Station	Design Day	24-hour PM-10 Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)
Higley	January 24, 2006	170	30

The objectives of this study were:

- To identify PM-10 sources within a two-kilometer radius of the Higley monitoring station;
- To determine individual source emissions based on existing PM-10 emissions inventories;
- To establish an emission inventory for the Higley monitoring station for the specified design day; and
- To predict future year PM-10 concentrations at the Higley monitoring station with rollback modeling.

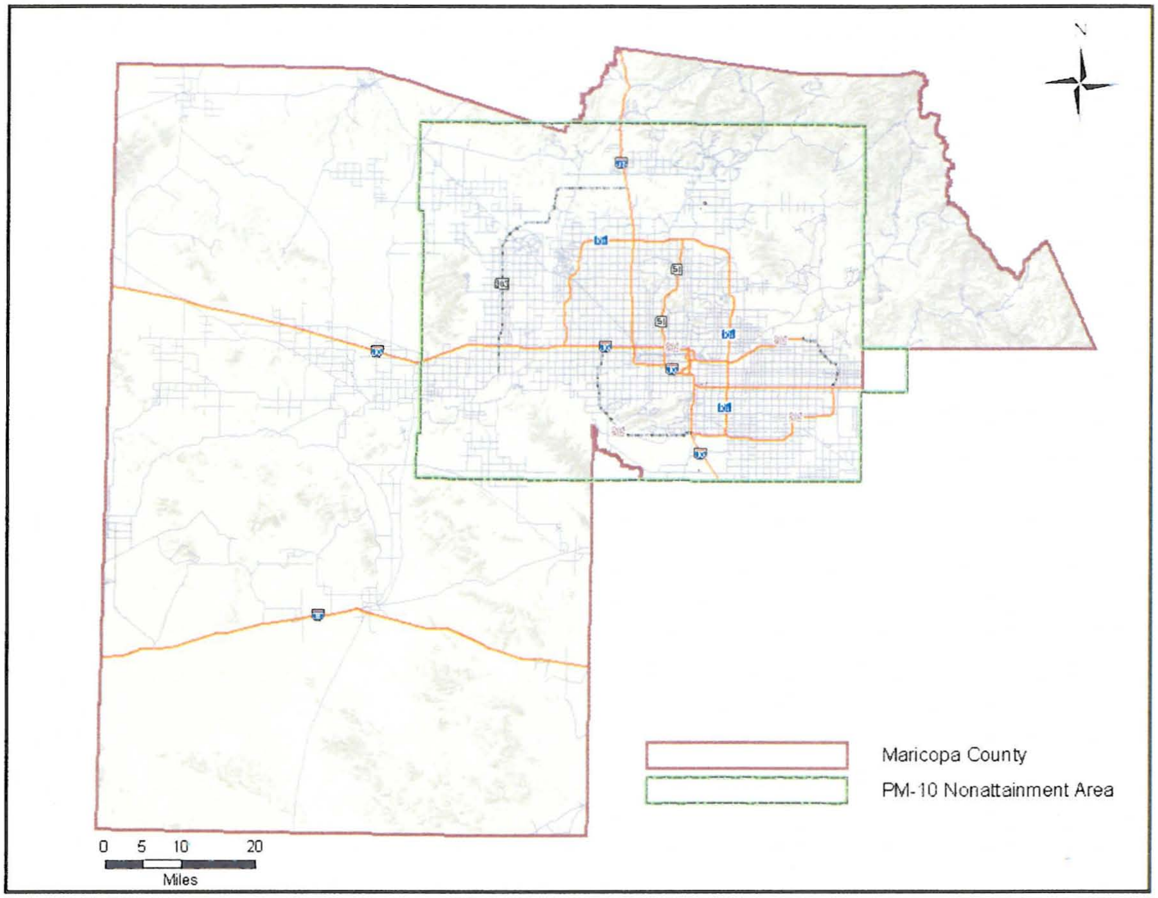

Figure VI-1. PM-10 Nonattainment Area

1. ORGANIZATION OF CHAPTER

A description of the Higley monitoring station and its location are provided in Section 2. Section 3 summarizes the meteorological data measured at the site for the selected design day. The proportional rollback model and modeling domain are described in Section 4. Potential PM-10 sources within 2 kilometers of the Higley station are presented in Section 5. The emissions inventory for the micro-scale modeling domain is presented in Section 6. Section 7 provides the attainment demonstration for the 24-hour PM-10 standard using the proportional rollback model. Conclusions are contained in Section 8.

2. MONITORING STATION

The Higley monitoring station is located at 15400 South Higley Road (west of Higley Road & north of Williams Field Road) in the Town of Gilbert. The monitor sits on the border of a water conservation facility. This site is in the southeast portion of the PM-10 nonattainment area as shown in Figure VI-2. Rapid development of agricultural fields into residential and commercial land use surrounding the site represents general environmental conditions of urban growth and expansion throughout the valley. This site is representative of other areas in the PM-10 nonattainment area that are transitioning from agriculture and vacant land to urban development. The PM-10 concentrations measured at the site are also typical of many other parts of the MNA. This is evidenced by the distribution of measured ambient PM-10 concentrations for all monitoring stations throughout the MNA for the three-year period of 2004-2006, as presented in Figure VI-3. The Higley site appears to have a similar distribution pattern to all other monitoring stations in the Valley, although high PM-10 concentrations at the Higley site occur more frequently.

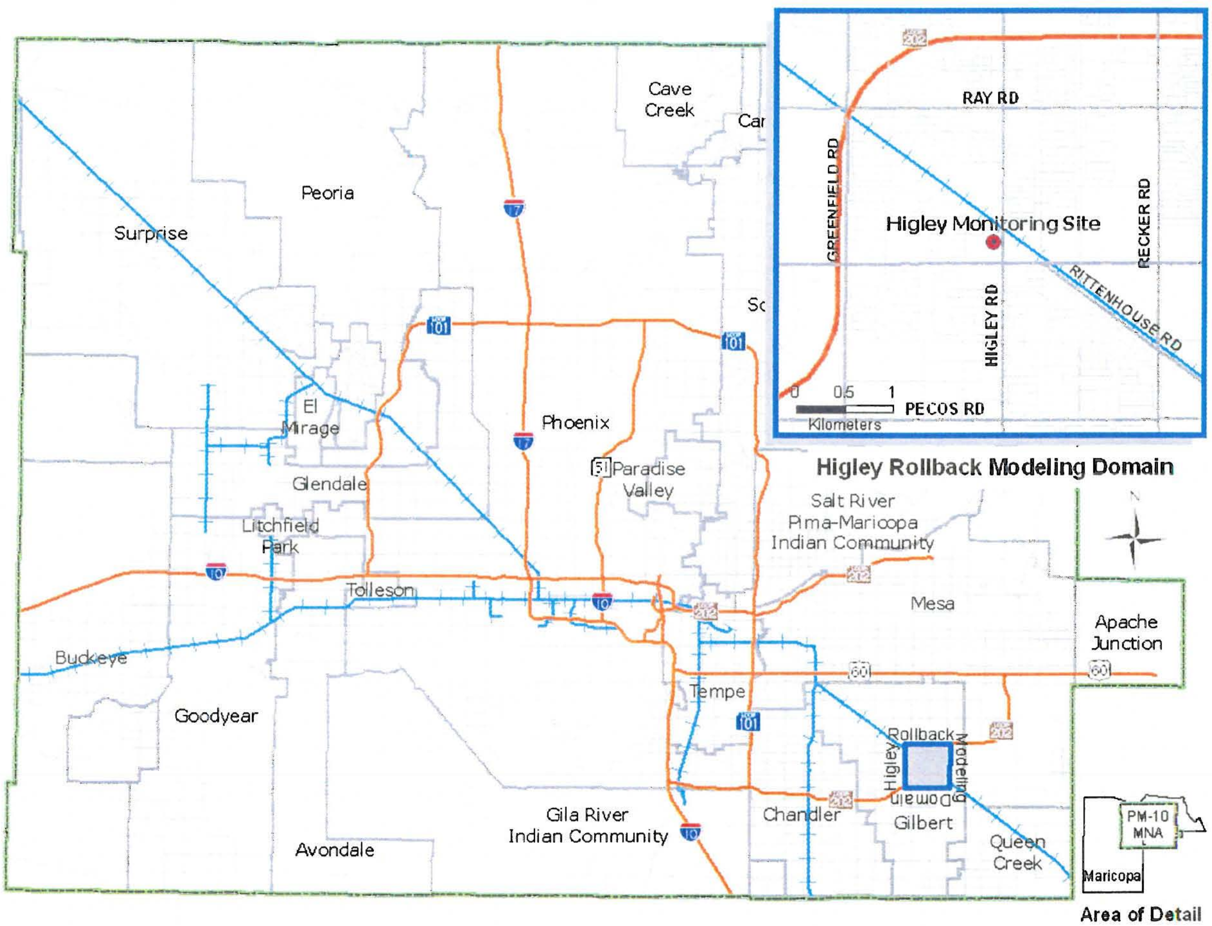

Figure VI-2. Map of the Higley monitoring station overlapped with the PM-10 MNA.

Distribution of Ambient PM-10 Concentrations for the Three-Year Period (2004-2006)

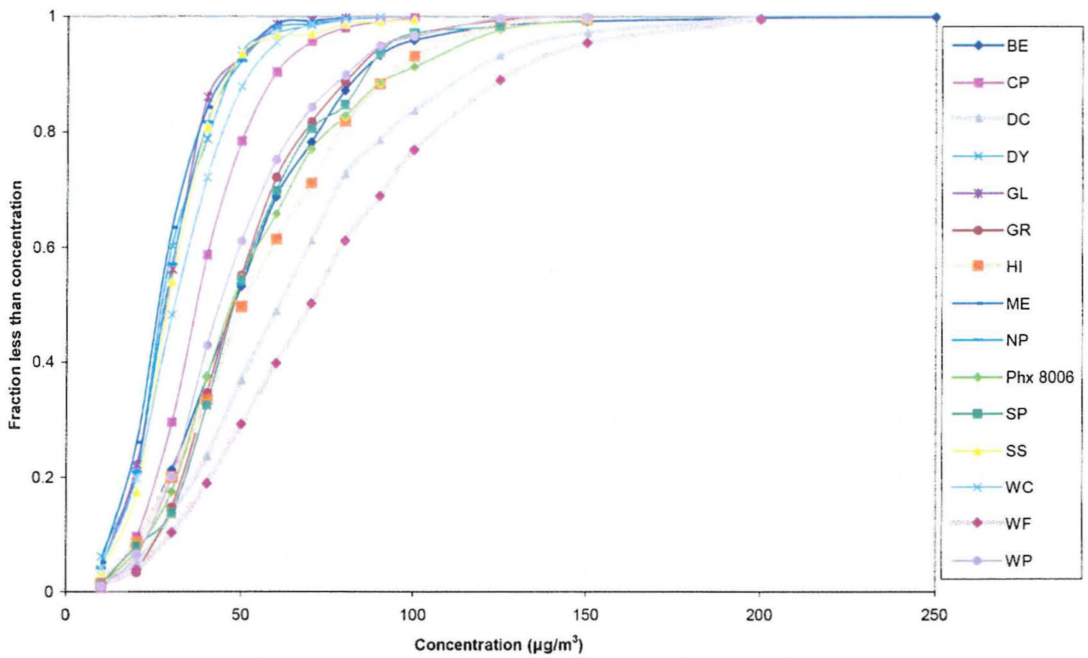

Figure VI-3. Distribution of ambient PM-10 concentrations for the three-year period 2004-2006: 15 monitoring stations in Maricopa County.

Note: Abbreviations for monitoring sites in the plot above are:
Buckeye (BE), Central Phoenix (CP), Durango Complex (DC), Dysart (DY), Glendale (GL), Greenwood (GR), Higley (HI), Mesa (ME), North Phoenix (NP), Phoenix 8006 (Phx 8006), South Phoenix (SP), South Scottsdale (SS), West Chandler (WC), West Forty-third (WF), West Phoenix (WP)

Originally, ADEQ set up this site in 1994 to monitor background particulate concentrations near the urban limits of Maricopa County and MCAQD installed a 1-in-6 day PM-10 monitor (SLAMS) in July 2000. The 1-in-6 day PM-10 monitor was replaced with an hourly continuous PM-10 monitor (an R&P TEOM monitor) in October 2004. The monitor inlet is located 2.9 meters above ground level and 1,000 meters above mean sea level. The Universal Transverse Mercator (UTM) coordinates for the site are 432,789.87 meters easting and 3,685,769.09 meters northing. Meteorological parameters measured at the site include wind speed and wind direction.

The annual distribution of measured ambient PM-10 concentrations at the Higley monitoring station for the three-year period of 2004-2006, as presented in Figure VI-4, shows a general pattern for all years. Overall, 2006 was the dustiest year and 2004 was the cleanest year, although one PM-10 exceedance was observed in 2004. The similar shape of the curves for each year indicates that the same PM-10 emission sources have contributed to the PM-10 problem at the Higley monitoring station in the past few years.

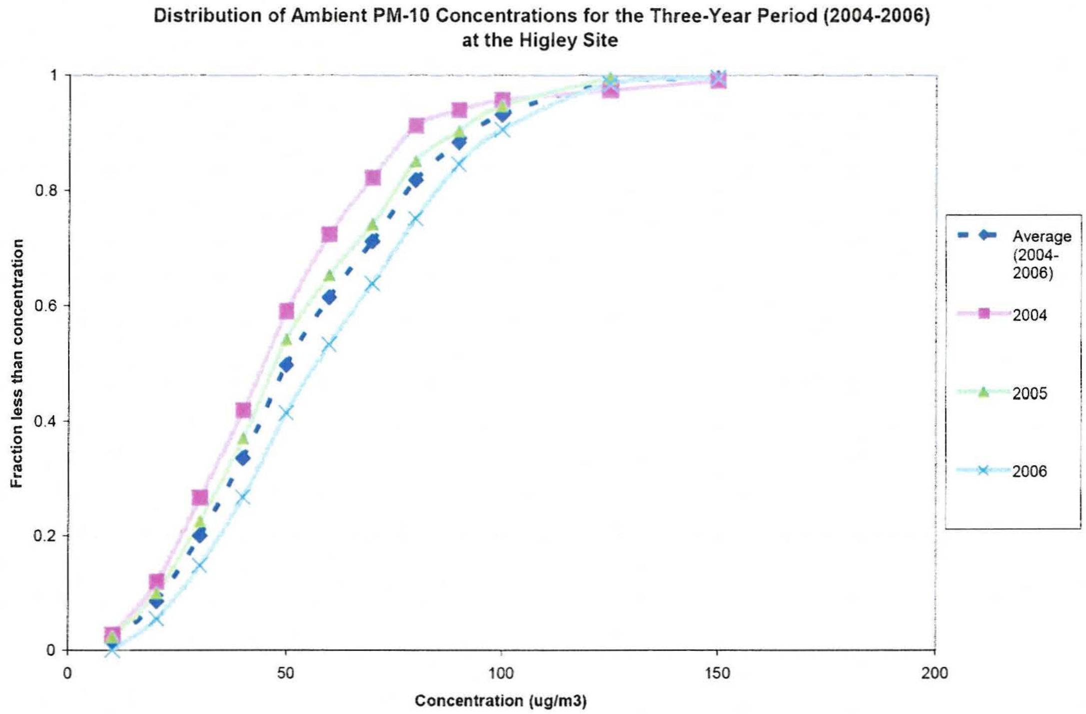

Figure VI-4. Distribution of ambient PM-10 concentrations for the three-year period of 2004-2006 at the Higley site.

In addition to the annual distribution analyses above, monthly average PM-10 concentrations for weekdays and weekend days in January for the period of 2005-2007, as shown in Figure VI-5, support that general PM-10 levels in 2006 were significantly higher than in other years. Also the weekday/weekend pattern provides strong evidence that high PM-10 concentrations at the Higley station are mainly caused by anthropogenic sources. This evidence is supported by significant morning and afternoon peaks of PM-10 concentrations during weekdays, which appear to be influenced by rush hour traffic, compared with much weaker diurnal variation with low PM-10 concentrations during weekend days, as shown in Figure VI-6. Regardless of the weekday/weekend effect, a similar pattern appears in the diurnal variation of high PM-10 levels in January for three years (2005-2007), as depicted in Figure VI-7. Lastly, Figure VI-8 shows the weekday/weekend effect and 2006 high PM-10 event at the Higley station from a daily perspective.

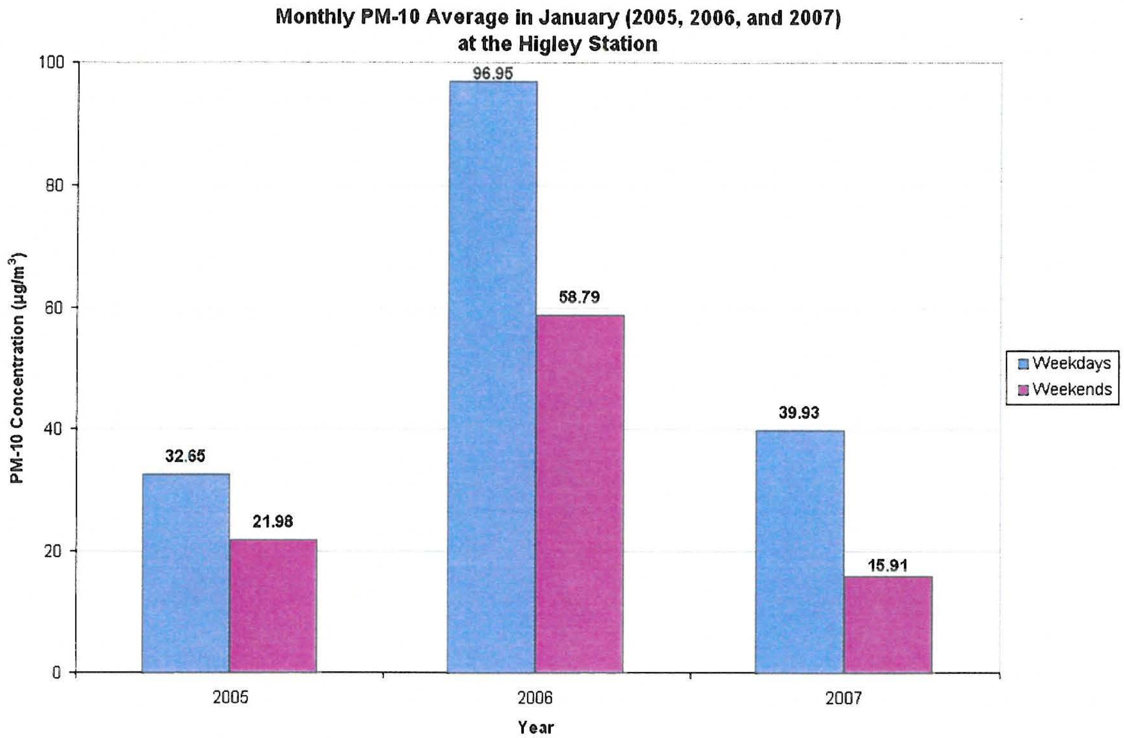

Figure VI-5. Weekday/weekend January average PM-10 concentrations for the three-year period of 2005-2007 at the Higley station.

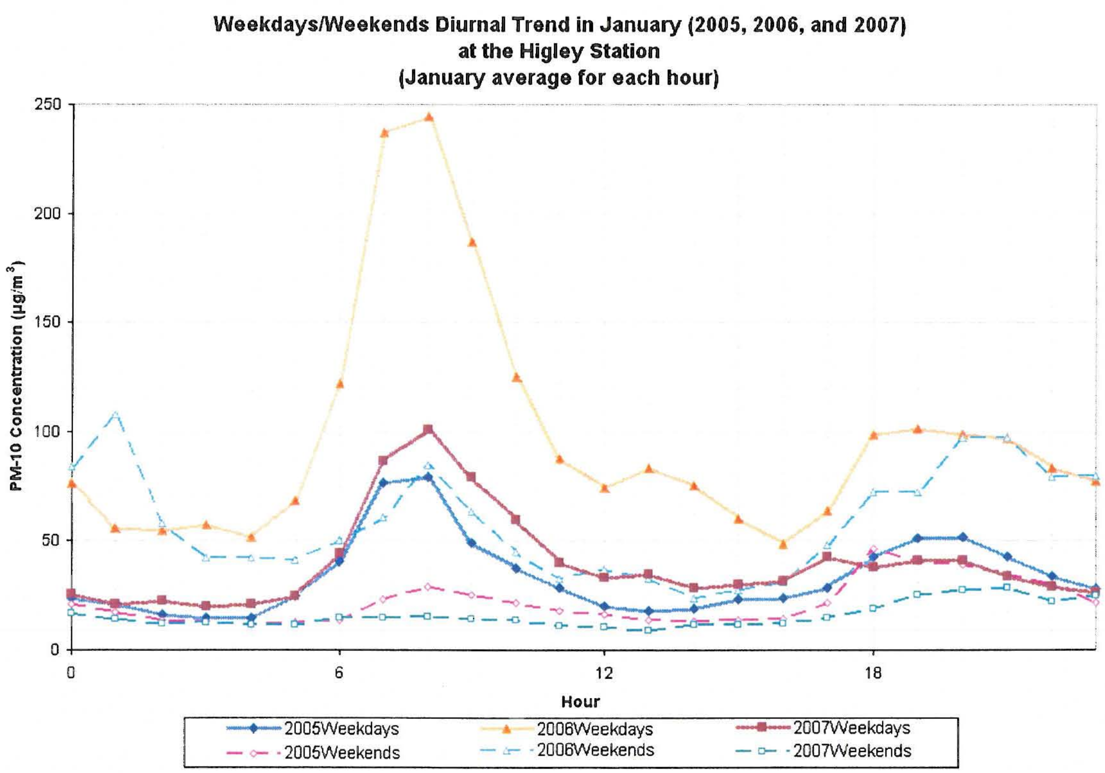

Figure VI-6. Weekday/weekend diurnal trend of January average PM-10 concentrations for the three-year period of 2005-2007 at the Higley station.

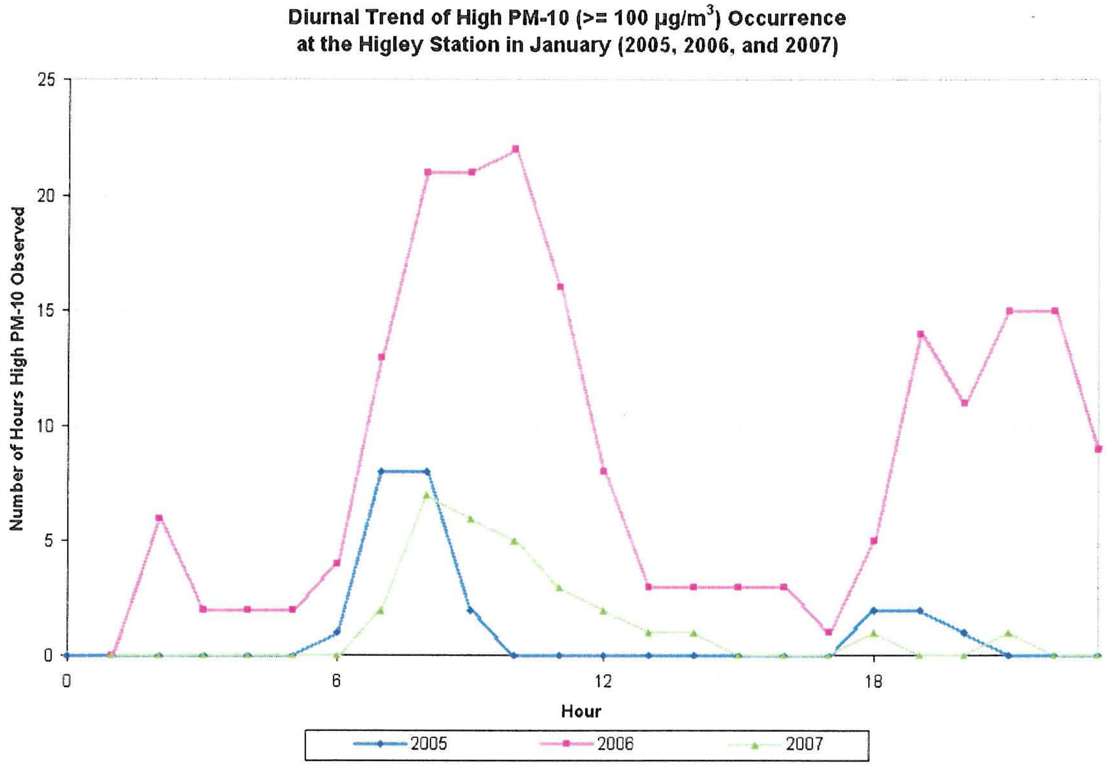

Figure VI-7. Diurnal variation of high PM-10 occurrence in January (2005, 2006, and 2007) at the Higley station.

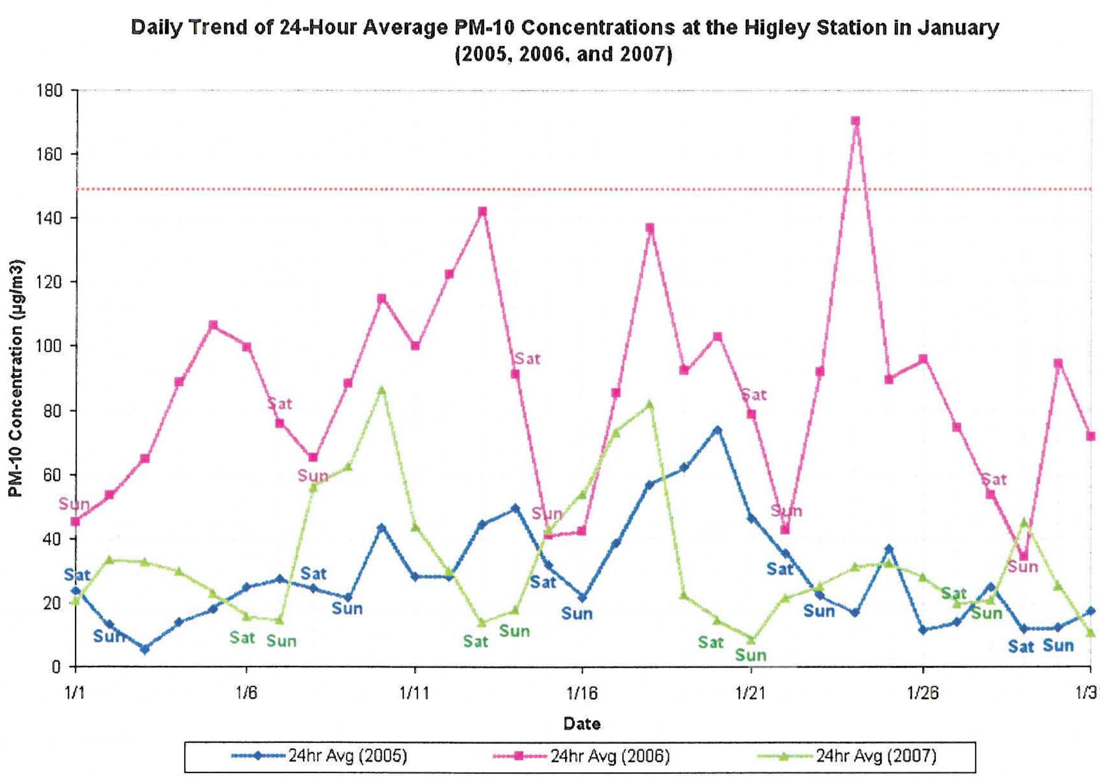

Figure VI-8. Daily variation of 24-hour average PM-10 concentrations in January (2005, 2006, and 2007) at the Higley station.

3. METEOROLOGICAL DATA

A wind rose of the wind speed and wind direction data collected by MCAQD at the Higley monitoring station on the design day, January 24, 2006, is presented in Figure VI-9. Winds were primarily blowing from the east, as measured at the Higley monitoring station on the design day. Wind speeds exceeded 15 mph for two hours and sustained winds exceeded 10 mph for 8 hours during the 24-hour period.

Figure VI-10 presents the relationship between occurrences of PM-10 concentrations greater than 100 $\mu g/m^3$ and wind speeds in January for three consecutive years from 2005 through 2007. In general, a majority of high PM-10 hours occurred under the conditions of wind speeds less than 3 mph and a minimal number of high PM-10 hours occurred at wind speeds greater than 15 mph.

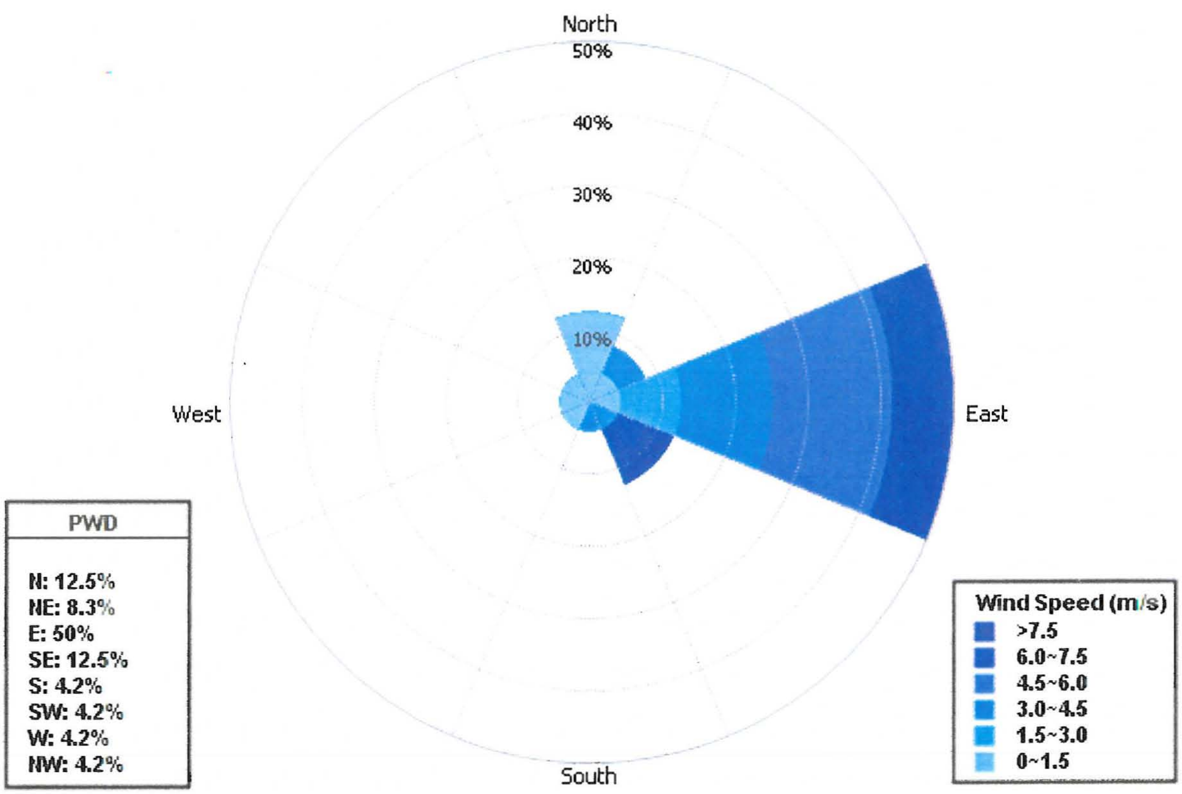

Figure VI-9. Wind rose at the Higley monitoring station on January 24, 2006.

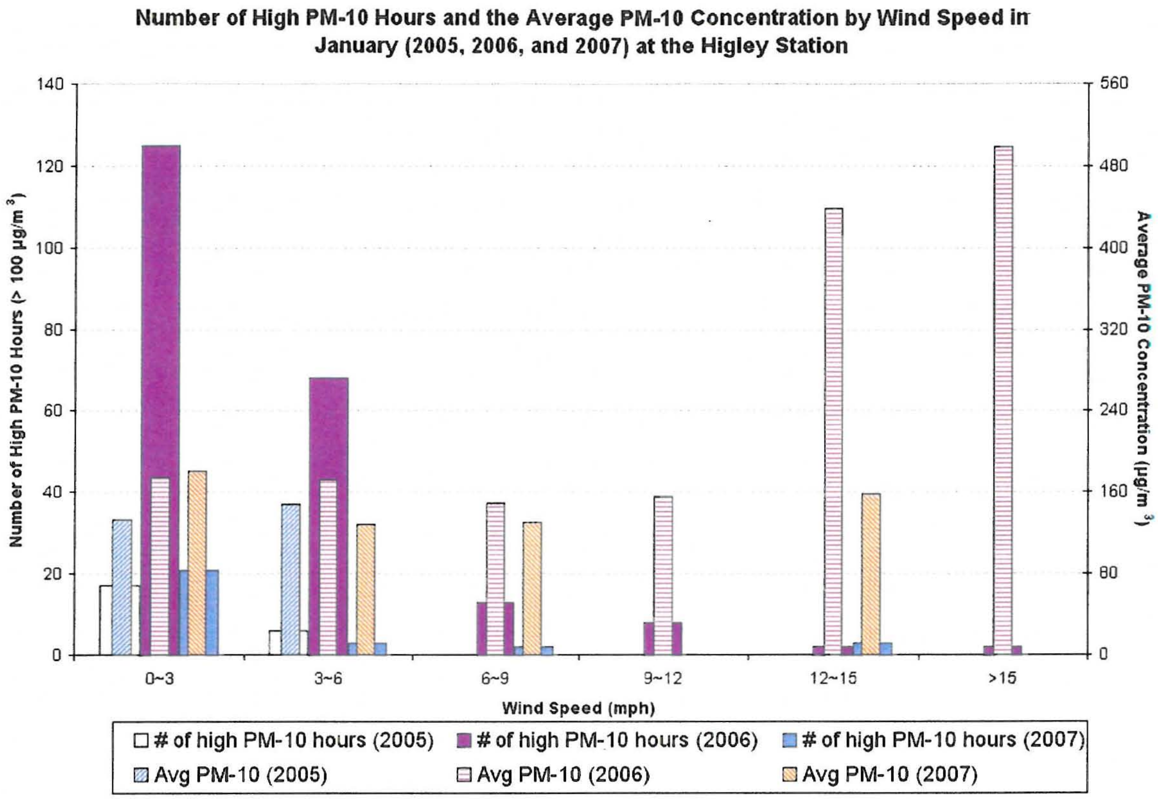

Figure VI-10. Number of high PM-10 hours and the average PM-10 concentrations by wind speed at the Higley monitoring station in January (2005, 2006, and 2007).

* High PM-10 indicates hourly PM-10 concentration greater than 100 µg/m^3.

4. ROLLBACK MODELING

The proportional rollback model assumes a linear relationship between PM-10 emissions from sources within a relatively short distance (1 to 2 kilometers) and their contribution to observed ambient PM-10 concentrations at the monitoring site. To calculate the anticipated ambient concentration, firstly, the base year concentration purely affected by the emissions sources in the modeling domain (ΔC_{base}) is calculated as below:

$$\Delta C_{base} = C_{base} - C_{background}$$

where C_{base} is the base year maximum 24-hour PM-10 concentration, which is the design value, and $C_{background}$ is the background PM-10 concentration. Secondly, a future-to-base year emission ratio ($R_{future\text{-}to\text{-}base}$), which indicates the degree of emissions change from base year to future year, is derived as below:

$$R_{future-to-base} = \frac{E_{future}}{E_{base}}$$

where E_{future} and E_{base} are the total PM-10 emissions in the modeling domain for future and base years, respectively. The future year concentration purely affected by the emissions sources in the modeling domain (ΔC_{future}) is derived by multiplying two values calculated above, as follows:

$$\Delta C_{future} = R_{future-to-base} \times \Delta C_{base}$$

Finally, the future year maximum 24-hour PM-10 concentration (C_{future}) is calculated as follows:

$$C_{future} = \Delta C_{future} + C_{background}$$

The basic steps for the rollback model are listed below:

- Determine representative monitoring station(s) and the design value;
- Determine background as the lowest PM-10 value recorded at an upwind monitoring station on the design day or during the same time period;
- Define a size of modeling domain surrounding the representative monitoring station(s);
- Prepare a micro-scale inventory of the sources that emit PM-10 for the time period the monitor was in operation;
- Calculate the percentage of each source based upon the entire inventory;
- Calculate the relative contribution from each source to the concentration measured for the time period;

- Estimate the anticipated increase or decrease in emissions of each source;
- Apply the same proportion of change in emissions from each source to the relative contribution calculated for the same source; and
- Calculate the anticipated ambient concentration after source emissions change.

The background PM-10 concentration will remain constant for the rollback modeling, even in future year. As for the secondary particulates, it is assumed that they are incorporated in the constant background and do not affect the rollback or primary emissions.

In general, the rollback modeling is applied to a relatively small area because the ambient PM-10 concentration measured at a monitor is driven by those sources located within a relatively short distance (1 to 2-kilometer) of monitoring site (CCDCP, 2001), and the zone of influence of fugitive dust (construction activities, paved and unpaved road dust, and windblown dust), which is the major contributor to the PM-10 emissions inventory for the MNA, is less than 2-kilometer (Chow et al., 1999). The size of the modeling domain for the Higley monitoring station was increased from the 2-kilometer by 2-kilometer modeling area (MAG, 2006) to the 4-kilometer by 4-kilometer modeling area because a road construction activity of the Santan Freeway, which was a significant contributing source surrounding the Higley monitoring station, was in progress outside of the 2-kilometer by 2-kilometer modeling area.

The proportional rollback modeling domain is a square, centered on the Higley monitoring station, having a two-kilometer radius as shown in Figure VI-11. This 4-kilometer by 4-kilometer modeling domain was divided into smaller grids as shown in Figure VI-12 to provide a more accurate spatial distribution of the sources. The domain was divided into squares measuring one kilometer on each side. Four grids adjacent to the Higley monitoring station were divided again into ½ kilometer squares to reflect the importance of nearby sources. The 28 grid squares were numbered to allow referencing of the emissions inventory by grid squares. The numbering started from the smaller grid squares in the order of west to east and north to south. After the smaller squares, the larger grid squares were numbered consecutively.

The rationale for selection of the monitoring station and its design value is explained in Chapters 1 and 2. The background PM-10 concentration on the design day is presented in Chapter 1 and is documented in Appendix VI, Exhibit 1. Detailed description of the modeling domain is provided in this section. This section is followed by the micro-scale emissions inventory and other calculations for the attainment demonstration.

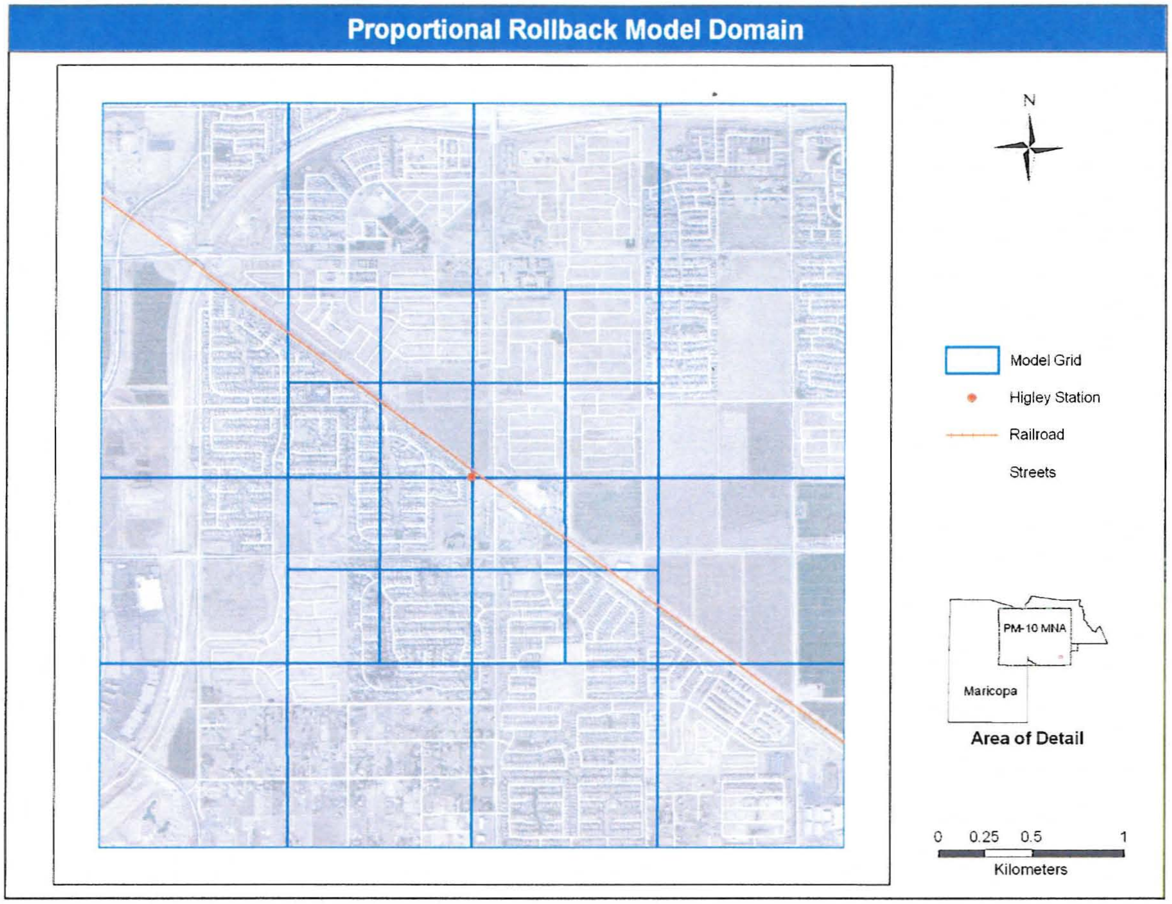

Figure VI-11. Proportional rollback modeling domain surrounding the Higley monitoring station.
* Aerial photo source: The Flood Control District of Maricopa County, 2006.

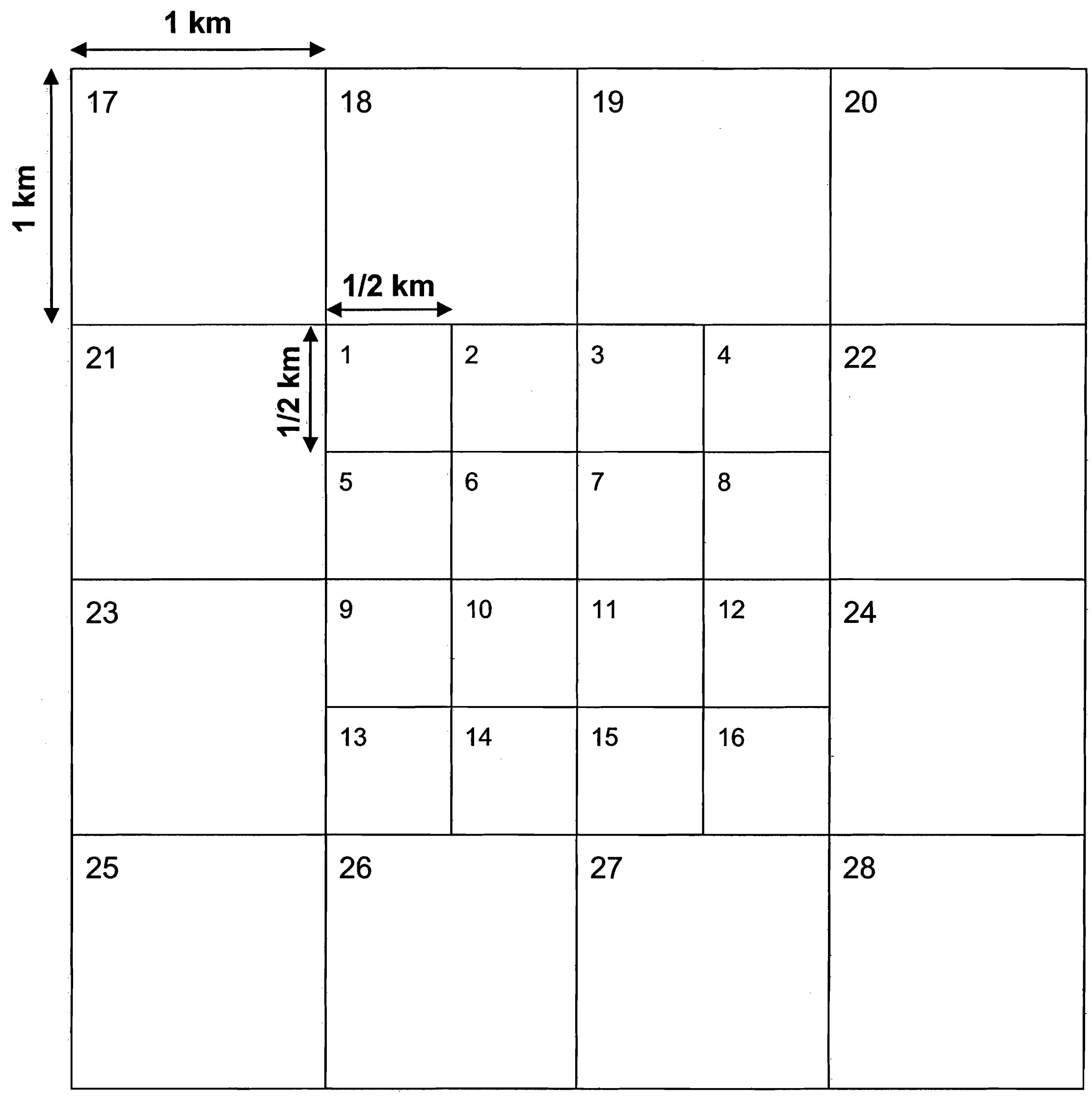

Figure VI-12. Emissions inventory grid structure.

5. EMISSIONS SOURCES IN THE HIGLEY MODELING DOMAIN

The micro-inventory area surrounding the Higley monitoring station contains several potential PM-10 emissions sources and activities associated with them. The land use representing potential PM-10 sources surrounding the Higley monitoring station is presented in Figure VI-13. Two major land use categories in the micro-inventory domain are construction sites and residential area, which are 1,255 acres (32%) and 1,251 acres (32%), respectively, of the modeling domain. Other land use categories include agricultural land (680 acres), vacant (374 acres), and commercial area (152 acres).

In January 2006, there were 9 major residential developments with permits totaling about 947 acres (24%) out of 3957 acres within the micro-inventory domain surrounding the Higley monitoring station. These developments were:

- Lyon's Gate (401 acres)
- Vincenz (116 acres)
- Higley Park (115 acres)
- William Lyon Homes at Cooley Station (115 acres)
- Agritopia (94 acres)
- Pecos Manor (38 acres)
- The Willows (29 acres)
- Ray Ranch (10 acres)
- The Gardens (9 acres)

In addition to residential developments, a portion (4 miles) of the Santan Freeway (Loop 202) was under construction along the north and west side of the micro-inventory domain. In the micro-inventory domain, there were 65 miles of paved roads and no stationary sources.

MCAQD performed monitor surveillance around the Higley station for one hour (3~4 pm) on January 24, 2006 right after high PM-10 observations under high wind conditions were reported. Figure VI-14 traces the route of the monitor surveillance for one hour. Several PM-10 emitting activities such as agriculture, travel on agriculture roads, earthmoving, dirt shoulders, haul roads, dirt road, and dust devils were observed at eleven locations during the surveillance. In the proximity of the Higley monitoring station, PM-10 emissions were mostly observed from dirt shoulders.

The activities of potential PM-10 emissions sources vary from day to day, month to month, and year to year. Some sources might not have emissions on the design day, even though located within the micro-inventory domain. The source contribution on the design day was considered to be average for most sources.

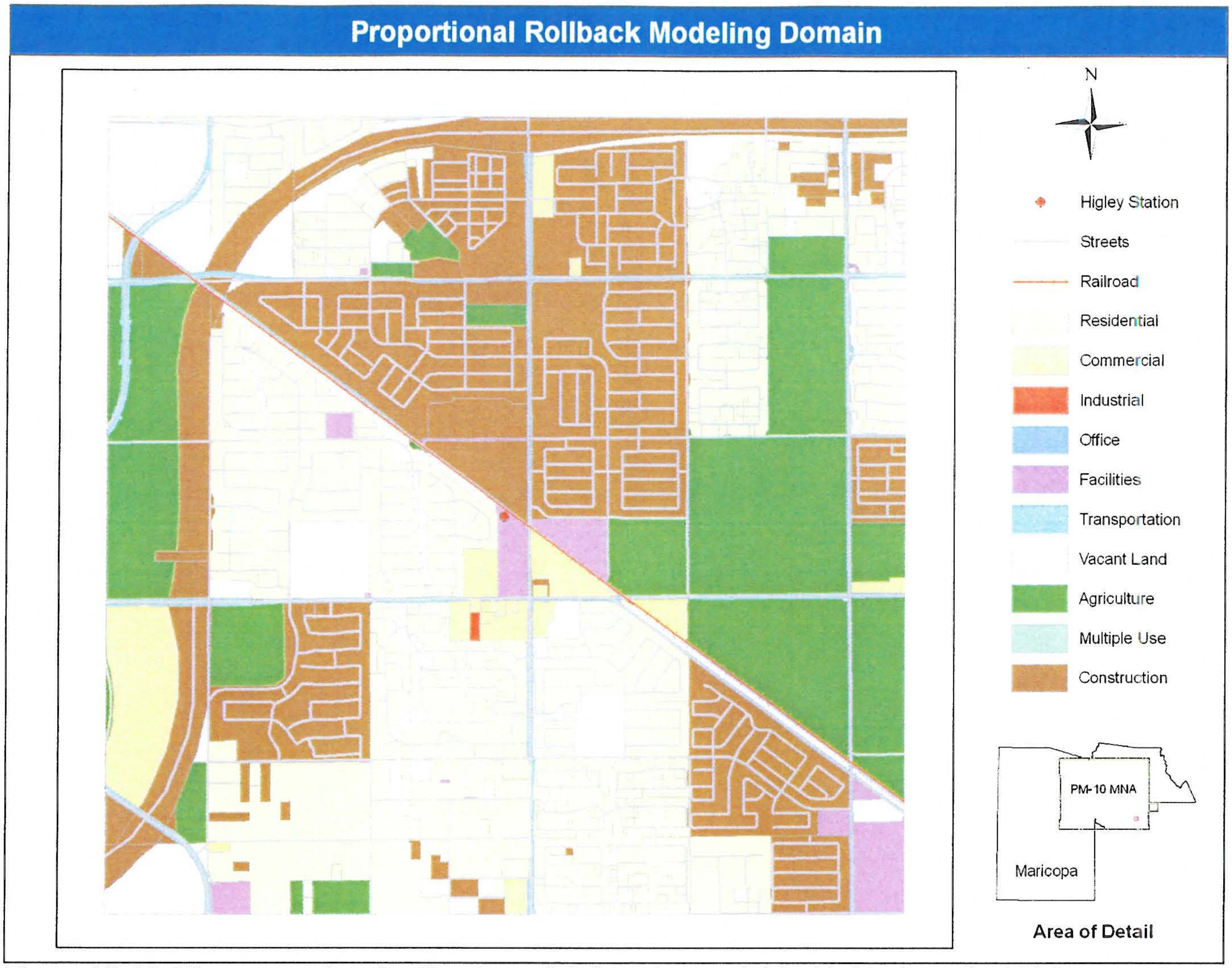

Figure VI-13. The proportional rollback model domain overlaid with land use in 2006.

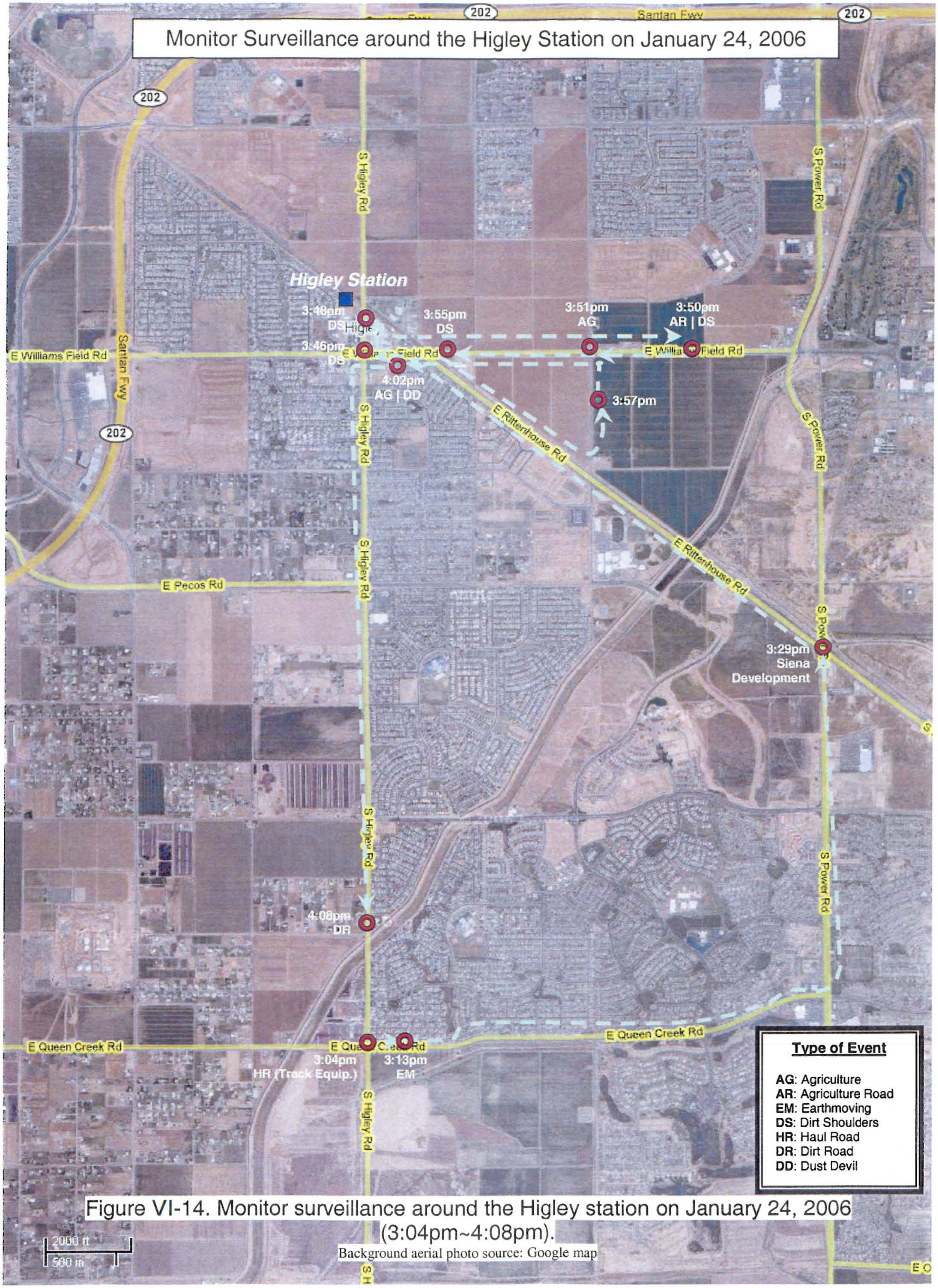

Figure VI-14. Monitor surveillance around the Higley station on January 24, 2006 (3:04pm~4:08pm).

Background aerial photo source: Google map

6. PM-10 EMISSIONS INVENTORY

A major component of the proportional rollback modeling process is the development of the micro-scale PM-10 emission inventory for the Higley modeling domain. The micro-scale PM-10 emissions inventories were prepared for the base year (2006) and the future year (2010). The 2010 emissions inventory was projected from the 2006 base year by examining the changes in land use and activities expected to occur in the next three years and applying control measures adopted as part of the PM-10 SIP. All acreage numbers appearing in this section were calculated using GIS based on the 2004 land use data, which is currently the latest data available, adjusted with the 2006 aerial photos.

6.1 BASE YEAR (2006) EMISSIONS INVENTORY

For the preparation of the micro-scale PM-10 emissions inventory for the base year of 2006, the 2005 Periodic Emission Inventory for PM-10 (PEI) from Maricopa County Air Quality Department (MCAQD, 2007) was the primary source for PM-10 emissions factors within the modeling domain. Emissions categories in the domain include construction activities, nonroad mobile sources, onroad mobile sources, agricultural activities, and windblown dust. There were no stationary sources in the micro-inventory domain. Detailed procedures and results of the emissions calculations are presented below.

6.1.1 CONSTRUCTION ACTIVITIES

Applying GIS, a total of 1,255 acres were determined to be construction sites based on the aerial photos taken on January 6 and February 1, 2006. Detailed acreage for each project type is listed in Table VI-2. Most construction activities were residential (75%), followed by road and commercial construction, which were 18% and 6%, respectively.

Table VI-2. Acreage of construction sites in the modeling domain based on the aerial photos taken on January 6 and February 1, 2006.

Project Type	Calculated Acres
Residential construction	947.31
Commercial construction	71.69
Road construction	229.78

As shown in Table IV-3, the average duration of construction activity and emissions factors for each project type were obtained from the 2005 PEI, which referenced the Western Regional Air Partnership (WRAP) Fugitive Dust Handbook (WRAP, 2006) and EIIP guidance (US EPA, 2002b).

Table VI-3. Average project duration and emissions factor by project type.

Project Type	Average duration (months)	Emissions factor (tons PM-10/acre-month)
Residential construction	6	0.032
Commercial construction	11	0.19
Road construction	12	0.265

Annual uncontrolled PM-10 emissions for each construction category in the modeling domain were calculated as follows:

Annual uncontrolled PM-10 emissions inside the micro-inventory domain (tons of PM-10/year)	= total acres	× number of months (months/year)	× emissions factor (tons of PM-10/acre-month)

According to the 2005 PEI in 2006, the control efficiency is 90% and the compliance rate with Maricopa County Rule 310 on dust control at construction sites is 51%. Annual controlled PM-10 emissions were calculated as below:

Annual controlled PM-10 emissions inside the micro-inventory domain (tons of PM-10/year)	= Uncontrolled PM-10 emissions (tons/year)	× [1 – (control efficiency × rule effectiveness)]

Uncontrolled and controlled annual PM-10 emissions from construction in the modeling domain are presented in Table VI-4. The comparatively large emission factor for road construction makes road construction the major PM-10 emission source among construction activities.

Table VI-4. Annual emissions from construction (tons/year) for the micro-inventory domain.

Project Type	Total acre-months	Emissions factor (tons PM-10/acre-month)	Uncontrolled PM-10 emissions (tons/year)	Controlled PM-10 emissions (tons/year)
Residential construction	5,683.86	0.032	181.88	98.40
Commercial construction	788.59	0.19	149.83	81.06
Road construction	2,757.36	0.265	730.70	395.31

Since the 2005 PEI assumed that construction activity occurs 6 days per week and evenly throughout the year, daily emissions were calculated by dividing annual emissions by 312 days (6 day/week × 52 weeks/year). Daily controlled PM-10 emissions were calculated as follows:

Daily controlled PM-10 emissions from construction activities inside the micro-inventory domain (lbs of PM-10/day)	= Annual controlled PM-10 emissions (tons/year)	× 2,000 (lbs/ton)	/ (6 days/week × 52 weeks/year)

Typical daily controlled PM-10 emissions for each construction category in the modeling domain are listed in Table VI-5.

Table VI-5. Annual and typical daily emissions from construction for the micro-inventory domain.

Project Type	Annual emissions (tons/year)	Typical daily emissions (lbs/day)
Residential construction	98.40	630.77
Commercial construction	81.06	519.62
Road construction	395.31	2,534.04

6.1.2 NONROAD MOBILE SOURCES

6.1.2.1 Agricultural Equipment

Adopting the method and results in the 2005 PEI, county average-day emissions for agricultural equipment were calculated by multiplying annual emissions (39.21 tons/year) by the most conservative weekday/weekend day activity allocation factor for agricultural equipment and dividing it by the number of weeks in the year (US EPA, 1999). Daily PM-10 emissions from agricultural equipment for the micro-inventory domain were calculated based on EIIP guidance (US EPA, 2002a) which recommends using the ratio of agricultural land inside the micro-scale domain (680 acres) to agricultural land inside the county (465,833 acres).

Daily PM-10 emissions from agricultural equipment inside the micro-inventory domain (lbs/day)	= Annual County PM-10 emissions (tons/year)	× Agricultural land use allocation factor (%)	× 2,000 (lbs/ton)	× Daily activity allocation factor for agricultural equipment (week/day)	/ 52 (weeks/year)
	= 39.21 tons/year = 0.37 lbs/day	× 0.1460 %	× 2,000	× 0.166667	/ 52

6.1.2.2 Construction Equipment

Typical daily PM-10 emissions from construction and mining equipment in Maricopa County, calculated by multiplying Maricopa County annual emissions by the most conservative weekday/weekend day activity allocation factor for construction/mining equipment and dividing it by the number of weeks (52) in the year (US EPA, 1999), were adopted from the 2005 PEI. Daily PM-10 emissions for the micro-inventory domain for this category were derived by applying the ratio of developing land in the micro-inventory domain (1,255 acres) to Maricopa County-level totals (68,664 acres). This was done because of the unavailability of EIIP recommended allocation factor based on total dollar amount of construction (US EPA, 2002a).

Daily PM-10 emissions from construction equipment inside the micro-inventory domain (lbs/day)	= Annual County PM-10 emissions (tons/year)	× Developing land use allocation factor (%)	× 2,000 (lbs/ton)	× Daily activity allocation factor for construction equipment (week/day)	/ 52 (weeks/year)
	= 1,354.26 tons/year = 158.69 lbs/day	× 1.828 %	× 2,000	× 0.166667	/ 52

6.1.2.3 Commercial Equipment

Annual emissions from commercial equipment in Maricopa County (generated by NONROAD2005) and weekday/weekend day activity allocation factor for commercial equipment were obtained from the 2005 PEI to calculate average-day emissions inside the micro-inventory domain. Model domain average-day emissions were derived by applying the ratio of commercial segment in the micro-inventory domain (152 acres) to Maricopa County-level totals (37,175 acres). This was done because data on the number of wholesale establishments recommended by EIIP guidance (US EPA, 2002a) was not available.

Daily PM-10 emissions from commercial equipment inside the micro-inventory domain (lbs/day)	= Annual County PM-10 emissions (tons/year)	× Commercial land use allocation factor (%)	× 2,000 (lbs/ton)	× Daily activity allocation factor for commercial equipment (week/day)	/ 52 (weeks/year)
	= 119.34 tons/year = 3.13 lbs/day	× 0.4089 %	× 2,000	× 0.166667	/ 52

6.1.2.4 Lawn and Garden Equipment

County annual PM-10 emissions from lawn and garden equipment and the conversion method to get county average-day emissions were acquired from the 2005 PEI. In the 2005 PEI, NONROAD2005 was used to calculate county annual PM-10 emissions from lawn and garden equipment. Weekday/weekend day activity allocation factors for lawn and garden equipment are 0.16 and 0.22 for the commercial and residential segments, respectively. Average-day emissions inside the micro-inventory domain were derived by applying the ratio of residential (1,251 acres) and commercial area (152 acres) inside the micro-scale domain to Maricopa County-level totals (402,966 and 37,175 acres, respectively).

Daily PM-10 emissions from lawn and garden equipment inside the micro-inventory domain (lbs/day)	= Annual County PM-10 emissions adjusted for residential area (tons/year)	× Residential land use allocation factor (%)	× 2,000 (lbs/ton)	× Daily activity allocation factor for lawn and garden equipment for residential area (week/day)	/ 52 (weeks/year)
	+ Annual County PM-10 emissions adjusted for commercial area (tons/year)	× Commercial land use allocation factor (%)	× 2,000 (lbs/ton)	× Daily activity allocation factor for lawn and garden equipment for residential area (week/day)	/ 52 (weeks/year)
	= 152.99 tons/year	× 0.3104 %	× 2,000	× 0.222222	/ 52
	+ 25.23 tons/year	× 0.4089 %	× 2,000	× 0.166667	/ 52
	= 4.72 lbs/day				

6.1.2.5 Locomotives

A railroad operated by Southern Pacific Railway, which is part of Union Pacific Railway (UP), crosses the micro-scale domain. Typical daily PM-10 emissions from locomotives in the micro-scale domain were calculated by multiplying Maricopa County emissions from UP Class I haul operations and UP yard/switching operations (extracted from the 2005 PEI) by the ratio of track miles inside the micro-inventory domain (16,279 ft) to Maricopa County (2,380,206 ft), derived by GIS mapping. Associated values for the PM-10 locomotive emissions calculation in the County are listed in Table VI-6.

Table VI-6. Values related to PM-10 locomotive emissions calculation in Maricopa County.

	Diesel fuel used (gals)	PM-10 emissions factor (lbs/gal diesel)	Annual emissions (tons/year)	Typical daily emissions (lbs/day)
UP Class I haul line	7,598,448	0.015	56.99	312.3
UP yard/switch operations	415,740	0.020	4.16	22.8

Daily PM-10 emissions from locomotive inside the micro-inventory domain (lbs/day)	= Typical daily PM-10 emissions in Maricopa County (lbs/day)	× Percentage of track miles inside the micro-inventory domain to Maricopa County (%)
	= 335.1 lbs/day	× 0.683932 %
	= 2.29 lbs/day	

6.1.3 ONROAD MOBILE SOURCES

6.1.3.1 Vehicle Exhaust, Tire Wear, and Brake Wear

Average-day motor vehicle exhaust, tire wear, and brake wear emissions in the micro-inventory domain were estimated using the MOBILE6.2 model with several assumptions as below:

- Applying actual January 2005 testing results provided by the Arizona Department of Weight and Measures to assume oxygen content and Reid Vapor Pressure (RVP) in January
- Reflecting the latest 2005 traffic assignment produced by MAG travel demand model to vehicle miles of travel (VMT)
- Applying January 2006 Maricopa County vehicle registration data from the Arizona Department of Transportation to obtain the MOBILE6.2 VMT mix
- Using the VMT mix generated by MOBILE6.2 to calculate the VMT by vehicle class
- Applying a factor (0.91) to convert average weekday to annual average daily traffic
- Multiplying the VMT by vehicle class by the appropriate MOBILE6.2 emissions factors to calculate vehicle exhaust, tire wear, and brake wear emissions

The total VMT of 165,775 miles/day for the micro-inventory domain is derived from the latest 2005 traffic assignment. Since the design day is early of 2006, which is closer to the 2005 traffic condition, the 2005 VMT was used. Also the 2005 VMT was used to avoid the impact from the Santan Freeway, which was completed in mid-2006. The VMT mix and the emissions factors by vehicle class generated by MOBILE6.2 are listed in Table VI-7. Annual average daily PM-10 emissions from vehicle exhaust, tire wear, and brake wear by vehicle class in the micro-inventory domain are listed in Table VI-8.

Table VI-7. 2006 annual average daily VMT and emissions factors by vehicle class for the micro-inventory domain.

Vehicle type	VMT Mix	Emission Factor (g/mile)		
		PM-10 Ext	PM-10 Tire	PM-10 Brake
LDGV	0.4044	0.005	0.008	0.013
LDGT1	0.0756	0.005	0.008	0.013
LDGT2	0.2517	0.005	0.008	0.013
LDGT3	0.0887	0.005	0.008	0.013
LDGT4	0.0408	0.005	0.008	0.013
HDGV2B	0.0297	0.056	0.008	0.013
HDGV3	0.0010	0.057	0.012	0.013
HDGV4	0.0004	0.060	0.012	0.013
HDGV5	0.0012	0.056	0.012	0.013
HDGV6	0.0026	0.055	0.012	0.013
HDGV7	0.0011	0.056	0.012	0.013
HDGV8A	0.0000	0.057	0.036	0.013
HDGV8B	0.0000	0.000	0.000	0.000
MC	0.0049	0.021	0.004	0.013
LDDV	0.0006	0.162	0.008	0.013
LDDT12	0.0002	0.352	0.008	0.013
LDDT34	0.0019	0.098	0.008	0.013
HDDV2B	0.0094	0.134	0.008	0.013
HDDV3	0.0029	0.122	0.012	0.013
HDDV4	0.0031	0.128	0.012	0.013
HDDV5	0.0014	0.120	0.012	0.013
HDDV6	0.0072	0.235	0.012	0.013
HDDV7	0.0105	0.240	0.012	0.013
HDDV8A	0.0128	0.289	0.036	0.013
HDDV8B	0.0449	0.305	0.036	0.013
HDGB	0.0002	0.083	0.012	0.013
HDDBT	0.0009	0.697	0.012	0.013
HDDBS	0.0017	0.478	0.012	0.013

Table VI-8. Annual average daily PM-10 emissions by vehicle class in the micro-inventory domain.

Vehicle type	Annual Average Daily PM-10 Emissions (lbs/day)			
	PM-10 Ext	PM-10 Tire	PM-10 Brake	PM-10 Total
LDGV	0.619	1.076	1.682	3.376
LDGT1	0.131	0.201	0.314	0.646
LDGT2	0.435	0.670	1.047	2.152
LDGT3	0.159	0.236	0.369	0.764
LDGT4	0.073	0.109	0.170	0.352
HDGV2B	0.557	0.079	0.123	0.760
HDGV3	0.019	0.004	0.004	0.027
HDGV4	0.008	0.002	0.002	0.011
HDGV5	0.022	0.005	0.005	0.032
HDGV6	0.048	0.010	0.011	0.069
HDGV7	0.020	0.004	0.005	0.029
HDGV8A	0.000	0.000	0.000	0.000
HDGV8B	0.000	0.000	0.000	0.000
MC	0.034	0.007	0.020	0.060
LDDV	0.032	0.002	0.002	0.036
LDDT12	0.023	0.001	0.001	0.025
LDDT34	0.062	0.005	0.008	0.075
HDDV2B	0.419	0.025	0.039	0.483
HDDV3	0.118	0.012	0.012	0.141
HDDV4	0.132	0.012	0.013	0.158
HDDV5	0.056	0.006	0.006	0.067
HDDV6	0.562	0.029	0.030	0.621
HDDV7	0.837	0.042	0.044	0.922
HDDV8A	1.231	0.153	0.053	1.438
HDDV8B	4.552	0.538	0.187	5.277
HDGB	0.005	0.001	0.001	0.007
HDDBT	0.209	0.004	0.004	0.216
HDDBS	0.270	0.007	0.007	0.284
Total	10.636	3.237	4.157	18.031

6.1.3.2 Paved Road Fugitive Dust

To calculate paved road fugitive emissions, the following PM-10 emissions factors using the AP-42 equation for fugitive dust from paved and unpaved roads (US EPA, 2006) were utilized:

- 0.18 g/VMT for freeways,
- 0.65 g/VMT for high average daily traffic (ADT) non-freeways (≥ 10,000 ADT), and;
- 1.70 g/VMT for low ADT non-freeways (< 10,000 ADT).

Derivative of the emissions factors for paved road is described in Chapter II. Average-day PM-10 paved road fugitive dust emissions were calculated by multiplying these emissions factors by the daily VMT for each road type within the micro-inventory domain. The daily VMT for each road type within the micro-inventory domain, derived from the latest 2005 traffic assignment, is shown in Table VI-9.

Table VI-9. Daily VMT for each road type within the micro-inventory domain derived from the latest 2005 traffic assignment.

Road Type	Daily VMT (miles/day)
Centroid	23,796
Low volume arterial (AWDT < 10,000)	40,886
High volume arterial (AWDT >= 10,000)	101,093
Freeway	0

The annual average VMT was derived by multiplying the daily VMT from the traffic assignment by a factor (0.91) to convert average weekday to annual average daily traffic, as follows:

Daily PM-10 paved road fugitive dust emissions inside the micro-inventory domain (lbs/day) = Daily VMT × Emissions factor × Conversion factor for average weekday to annual average daily traffic (0.91)

Annual average daily PM-10 emissions from paved road fugitive dust in the micro-inventory domain are listed in Table VI-10.

Table VI-10. 2006 annual average daily PM-10 emissions from paved road fugitive dust in the micro-inventory domain.

Road Type	Daily PM-10 (lbs/day)
Centroid	81.16
Low volume arterial (AWDT < 10,000)	139.44
High volume arterial (AWDT >= 10,000)	131.83
Freeway	0

6.1.3.3 Trackout

Average-day PM-10 trackout emissions for each major arterial link within the micro-inventory domain were calculated by multiplying the daily traffic count for each arterial link by 100 feet for compliance and 500 feet for non-compliance, the number of trackout points for each arterial link, the trackout factor (six times the PM-10 emissions factors above), and a conversion factor (0.91) of average weekday to annual average daily traffic. The 2006 vehicle counts for each arterial link were derived from the actual 2006 vehicle counts (MAG, 2007). The factor of 6 for trackout emissions is derived from AP-42.

Daily controlled PM-10 trackout emissions from each major arterial link inside the micro-inventory domain (lbs/day)	= Traffic count	× 100 ft	× Compliance rate (51%)	× Conversion factor from feet to mile (0.0001894)	× Number of trackout points	× Emissions factor	× Trackout factor	× Conversion factor for average weekday to annual average daily traffic (0.91)
	+ Traffic count	× 500 ft	× Non-compliance rate (49%)	× Conversion factor from feet to mile (0.0001894)	× Number of trackout points	× Emissions factor	× Trackout factor	× Conversion factor for average weekday to annual average daily traffic

Daily PM-10 trackout emissions from major arterials inside the micro-inventory domain were calculated by accumulating trackout emissions from each major arterial link, as shown below:

Daily controlled PM-10 trackout emissions from major arterials inside the micro-inventory domain (lbs/day) $= \sum_{\text{arterial link}=1}^{24} (\text{Controlled trackout emission for an arterial link})$

= 198.11 lbs/day

6.1.4 AGRICULTURAL ACTIVITIES

6.1.4.1 Tilling and Harvesting

Since specific crop information for the agricultural area in the micro-inventory domain was not available, controlled typical average-day PM-10 emissions from tilling and harvesting for the micro-inventory domain were derived by multiplying typical daily County PM-10 emissions from each category (obtained from the 2005 PEI) by the ratio of agricultural area inside the micro-scale domain (680 acres) to agricultural area inside Maricopa County (465,833 acres).

Typical daily PM-10 emissions from tilling inside the micro-inventory domain (lbs/day)	= Daily County PM-10 emissions from tilling (lbs/day)	× Agricultural land use allocation factor
	= 30,241.4 lbs/day	× 0.1460 %
	= 44.15 lbs/day	

Typical daily PM-10 emissions from harvesting inside the micro-inventory domain (lbs/day)	= Daily County PM-10 emissions from harvesting (lbs/day)	× Agricultural land use allocation factor
	= 3,489.9 lbs/day	× 0.1460 %
	= 5.10 lbs/day	

6.1.4.2 Travel on Unpaved Agricultural Roads

According to the 2005 PEI, an unpaved road emission factor derived from AP-42 13.2.2 (US EPA, 2006), as shown below, was applied to estimate PM-10 emissions from travel on unpaved agricultural roads:

$$\begin{aligned}
\textit{Unpaved road emission factor } (EF)(lb/VMT) &= k\left(\frac{s}{12}\right)^a\left(\frac{W}{3}\right)^b \\
&= 1.5\left(\frac{11.9}{12}\right)^{0.9}\left(\frac{2.8}{3}\right)^{0.45} \\
&= 1.44\, lb/VMT
\end{aligned}$$

where:

k = 1.5 (US EPA, 2006),
a = 0.9 (US EPA, 2006),
b = 0.45 (US EPA, 2006),
s = surface material silt content, which is 11.90% (MAG, 2000), and
W = mean vehicle weight, which is 2.80 tons (URS and ERG, 2001)

Uncontrolled daily PM-10 emissions from travel on unpaved agricultural roads were estimated as below:

Uncontrolled daily PM-10 emissions from unpaved agricultural roads inside the micro-inventory domain (lbs/day)	= Unpaved road emissions factor (lbs/VMT)	× Farm vehicle activity factor (daily VMT per 1,000 acres)	× Agricultural area in the micro-inventory domain (acres)
	= 1.44 lbs/VMT	× 49.5 VMT/1000 acres	× 680 acres
	= 48.47 lbs/day		

Since the micro-inventory domain is located within the PM-10 NAA, controlled emissions from travel on unpaved agricultural roads were estimated by applying the mid-point net control efficiency from two agricultural best management practices (BMP), which are 12.4% and 0.4% for access restriction and reduced vehicle speed, respectively, used in the 2005 PEI.

Controlled daily PM-10 emissions from unpaved agricultural roads inside the micro-inventory domain (lbs/day)	= Daily uncontrolled PM-10 emissions from travel on unpaved agricultural roads (lbs/day)	× (100% - mid-point net control efficiency)
	= 48.47 lbs/day	× (100 % - 12.8 %)
	= 42.27 lbs/day	

6.1.5 WINDBLOWN DUST

Based on ENVIRON's windblown dust modeling study (MCAQD, 2007), monthly PM-10 windblown dust emissions for Maricopa County were estimated as 2,187 tons in January 2005. Table VI-11 presents the monthly and daily PM-10 windblown dust emissions for each land-use category. Average-day PM-10 emissions for the micro-inventory domain were derived by applying the ratio of the area of land use categories for the micro-inventory domain to Maricopa County-level totals as presented in Table VI-12.

Table VI-11. Monthly and daily PM-10 windblown dust emissions for Maricopa County in January 2005.

Land Use Category	LU code	Monthly PM-10 emissions (tons/month)	Daily PM-10 emissions (lbs/day)
Vacant	700~731, 900	2,001.73	129,143.90
Residential Construction	910	30.93	1,995.48
Commercial Construction	920~950, 980	4.60	296.77
Transportation Construction	960	0.30	19.35
Developed	100~570, 580~621, 800~899, 999	0.00	0.00
Water (Alluvial)	740	41.40	2,670.97
Agricultural	750	6.65	429.04
Other	571~574	101.56	6,552.26
Total		2,187.16	141,107.77

Table VI-12. Windblown dust calculation results for the corresponding land use categories based on land use allocation factors (Maricopa County to the micro-inventory domain) for the micro-inventory domain.

Land Use Category	Area of Maricopa County (acre)	Area of micro-inventory domain (acre)	Land use allocation factor (%)	PM-10 emissions of Maricopa County (lbs/day)	PM-10 emissions of micro-inventory domain (lbs/day)
Vacant	2,039,335	374	0.0183	129,143.90	23.63
Residential Construction	47,324	947	2.0011	1,995.48	39.93
Commercial Construction	10,163	72	0.7085	296.77	2.10
Transportation Construction	4,248	230	5.4143	19.35	1.05
Developed	547,005	1,649	0.3177	0.00	0
Water (Alluvial)	40,778	0	0	2,670.97	0
Agricultural	465,833	680	0.1460	429.04	0.63
Other	22,448	0	0	6,552.26	0
Total				141,107.77	67.34

6.2 FUTURE YEAR (2010) EMISSIONS INVENTORY BASED ON LAND USE PROJECTION WITH COMMITTED CONTROL MEASURES IN THE FIVE PERCENT PLAN

Since the emissions sources within the micro-inventory domain are heavily influenced by land uses in general, the future year emissions inventory was derived by multiplying the base year emissions inventory generated above by the ratio of land use change from base year to future year and applying control measures. Between 2006 and 2010, land use in the micro-inventory domain changes due to the conversion of agricultural land to construction area (during the development) or residential area (after the development). Thus, MAG data on major developments (MAG, 2005) was applied to project the future year land uses. Based on the major development data base, agricultural land was eliminated from the future year emissions inventory. Detailed procedures and results of the emissions calculations are presented below.

6.2.1 CONSTRUCTION ACTIVITIES

Based on the MAG major development data base, a total of 463 acres is expected to be construction sites in 2010. Detailed acreage for each project type is listed in Table VI-13. Residential construction continues to be the largest portion of construction activities in the future year. Since the road construction activity of the Santan Freeway (Loop 202) was completed in the middle of 2006, road construction was also eliminated from the future year emissions inventory.

Table VI-13. Acreage of construction sites within the micro-inventory domain in the future year.

Project Type	Calculated Acres
Residential construction	452
Commercial construction	11

The same average duration of construction activity and emissions factors for each project type used for the base year were applied as shown in Table VI-14.

Table VI-14. Average project duration and emissions factor by project type.

Project Type	Average Duration (months)	Emissions Factor (tons PM-10/acre-month)
Residential construction	6	0.032
Commercial construction	11	0.19

Annual uncontrolled PM-10 emissions for each construction category in the modeling domain were derived as follows:

Annual uncontrolled PM-10 emissions inside the micro-inventory domain (tons of PM-10/year) = total acres × number of months (months/year) × emissions factor (tons of PM-10/acre-month)

Committed control measures in the Five Percent Plan (i.e. measures #2, 3, 8, 9, 10, 16, 36, 37, 38, and 44) increase the compliance with Rule 310 from 51% to 80% in 2010 and result in about 48% reduction of construction emissions by 2010. Annual controlled PM-10 emissions were calculated by applying the control efficiency of the uncontrolled emissions (90%) and compliance rate on dust control at construction sites (80%), as shown below:

Annual controlled PM-10 emissions inside the micro-inventory domain (tons of PM-10/year)	= Uncontrolled PM-10 emissions (tons/year)	× [1 – (control efficiency × rule effectiveness)]

Uncontrolled and controlled annual PM-10 emissions from construction within the micro-inventory domain are presented in Table VI-15.

Table VI-15. Annual emissions from construction for the micro-inventory domain in the future year.

Project Type	Total acre-months	Emissions factor (tons PM-10 /acre-month)	Uncontrolled PM-10 (tons/year)	Controlled PM-10 (tons/year)
Residential construction	2,712	0.032	86.78	24.30
Commercial construction	121	0.19	22.99	6.44

Average-day controlled PM-10 emissions for the future year were calculated in the same manner used for the base year emissions inventory as below:

Daily controlled PM-10 emissions from construction activities inside the micro-inventory domain (lbs of PM-10/day)	= Annual controlled PM-10 emissions (tons/year)	× 2,000 (lbs/ton)	/ (6 days/week × 52 weeks/year)

Typical daily controlled PM-10 emissions for each construction category in the micro-inventory domain are listed in Table VI-16.

Table VI-16. Annual and typical daily emissions from construction within the micro-inventory domain in the future year.

Project Type	Annual emissions (tons/year)	Typical daily emissions (lbs/day)
Residential construction	24.30	155.77
Commercial construction	6.44	41.28

6.2.2 NONROAD MOBILE SOURCES

6.2.2.1 Agricultural Equipment

According to the planned land use conversion from agricultural area to residential, commercial, or construction land uses by 2010 (MAG, 2005), there will be no PM-10 emissions from agricultural equipment inside the micro-inventory domain.

6.2.2.2 Construction Equipment

Average-day PM-10 emissions from construction equipment within the micro-inventory domain in 2010 was projected by using the ratio of planned construction area in the future year (463 acres) to the base year totals (1,255 acres), as shown below:

Daily PM-10 emissions from construction equipment inside the micro-inventory domain in 2010 (lbs/day)	= Daily PM-10 emissions from construction equipment inside the micro-inventory domain in base year (lbs/day)	× Developing land use allocation factor
	= 158.69 lbs/day	× 36.89 %
	= 58.54 lbs/day	

6.2.2.3 Commercial Equipment

Daily PM-10 emissions from commercial equipment within the micro-inventory domain in 2010 were projected using the ratio of planned commercial area in future year (279 acres) to the base year totals (152 acres), as shown below:

Daily PM-10 emissions from commercial equipment inside the micro-inventory domain in 2010 (lbs/day)	= Daily PM-10 emissions from commercial equipment inside the micro-inventory domain in base year (lbs/day)	× Commercial land use allocation factor
	= 3.13 lbs/day	× 183.5526 %
	= 5.75 lbs/day	

6.2.2.4 Lawn and Garden Equipment

Average-day PM-10 emissions from lawn and garden equipment within the micro-scale domain in 2010 were calculated using the ratio of planned residential and commercial areas in future year to the base year totals, as below:

Daily PM-10 emissions from lawn and garden equipment inside the micro-inventory domain in 2010 (lbs/day)	= Daily PM-10 emissions from lawn and garden equipment used in residential area inside the micro-inventory domain in base year (lbs/day)	× Residential land use allocation factor
	+ Daily PM-10 emissions from lawn and garden equipment used in commercial area inside the micro-inventory domain in base year (lbs/day)	× Commercial land use allocation factor
	= 4.06 lbs/day	× 178.6571 %
	+ 0.66 lbs/day	× 183.5526 %
	= 8.46 lbs/day	

6.2.2.5 Locomotives

Since there is no railroad expansion planned within the micro-inventory domain, average-day PM-10 emissions from locomotives will remain the same value, 2.29 lbs/day, used for the base year emissions inventory.

6.2.3 ONROAD MOBILE SOURCES

6.2.3.1 Vehicle Exhaust, Tire Wear, and Brake Wear

Average-day motor vehicle exhaust, tire wear, and brake wear emissions in the micro-inventory domain for 2010 were estimated using the MOBILE6.2 model with several assumptions as below:

- Applying actual January 2005 testing results provided by the Arizona Department of Weight and Measures to assume oxygen content and Reid Vapor Pressure (RVP) in January
- Reflecting the latest 2010 traffic assignment produced by the MAG travel demand model to obtain vehicle miles of travel (VMT)
- Applying January 2010 Maricopa County vehicle registration data, which was estimated by using January 2006 data from the Arizona Department of Transportation, to obtain the MOBILE6.2 VMT mix
- Applying the average diesel fuel sulfur level of 15 ppm
- Using the VMT mix generated by MOBILE6.2 to calculate the VMT by vehicle class
- Applying a factor (0.91) to convert average weekday to annual average daily traffic
- Multiplying the VMT by vehicle class by the appropriate MOBILE6.2 emission factors to calculate vehicle exhaust, tire wear, and brake wear emissions

The total VMT of 506,095 miles/day for the micro-inventory domain in 2010 is derived from the latest 2010 traffic assignment. The VMT mix and the emissions factors by vehicle class generated by MOBILE6.2 are listed in Table VI-17. Annual average daily PM-10 emissions from vehicle exhaust, tire wear, and brake wear by vehicle class in the micro-inventory domain are listed in Table VI-18.

Table VI-17. 2010 VMT mix and emissions factors by vehicle class for the micro-inventory domain.

Vehicle type	VMT Mix	Emission Factor (g/mile)		
		PM-10 Ext	PM-10 Tire	PM-10 Brake
LDGV	0.3505	0.004	0.008	0.013
LDGT1	0.0846	0.005	0.008	0.013
LDGT2	0.2818	0.005	0.008	0.013
LDGT3	0.0992	0.005	0.008	0.013
LDGT4	0.0456	0.005	0.008	0.013
HDGV2B	0.0300	0.036	0.008	0.013
HDGV3	0.0010	0.035	0.012	0.013
HDGV4	0.0003	0.036	0.012	0.013
HDGV5	0.0012	0.035	0.012	0.013
HDGV6	0.0025	0.034	0.012	0.013
HDGV7	0.0010	0.035	0.012	0.013
HDGV8A	0.0000	0.036	0.036	0.013
HDGV8B	0.0000	0.000	0.000	0.000
MC	0.0047	0.021	0.004	0.013
LDDV	0.0003	0.053	0.008	0.013
LDDT12	0.0000	0.351	0.008	0.013
LDDT34	0.0022	0.047	0.008	0.013
HDDV2B	0.0092	0.061	0.008	0.013
HDDV3	0.0028	0.049	0.012	0.013
HDDV4	0.0032	0.059	0.012	0.013
HDDV5	0.0015	0.056	0.012	0.013
HDDV6	0.0073	0.101	0.012	0.013
HDDV7	0.0106	0.100	0.012	0.013
HDDV8A	0.0128	0.117	0.036	0.013
HDDV8B	0.0448	0.126	0.036	0.013
HDGB	0.0001	0.057	0.012	0.013
HDDBT	0.0009	0.295	0.012	0.013
HDDBS	0.0018	0.257	0.012	0.013

Table VI-18. 2010 annual average daily PM-10 emissions by vehicle class in the micro-inventory domain.

Vehicle type	Annual Average Daily PM-10 Emissions (lbs/day)			
	PM-10 Ext	PM-10 Tire	PM-10 Brake	PM-10 Total
LDGV	1.566	2.847	4.449	8.862
LDGT1	0.404	0.687	1.074	2.165
LDGT2	1.345	2.289	3.577	7.211
LDGT3	0.484	0.806	1.259	2.548
LDGT4	0.222	0.370	0.579	1.171
HDGV2B	1.084	0.244	0.381	1.709
HDGV3	0.036	0.012	0.013	0.061
HDGV4	0.011	0.004	0.004	0.018
HDGV5	0.042	0.015	0.015	0.072
HDGV6	0.087	0.030	0.032	0.149
HDGV7	0.036	0.012	0.013	0.061
HDGV8A	0.000	0.000	0.000	0.000
HDGV8B	0.000	0.000	0.000	0.000
MC	0.098	0.019	0.060	0.177
LDDV	0.016	0.002	0.004	0.022
LDDT12	0.000	0.000	0.000	0.000
LDDT34	0.105	0.018	0.028	0.151
HDDV2B	0.570	0.075	0.117	0.761
HDDV3	0.139	0.034	0.036	0.209
HDDV4	0.191	0.039	0.041	0.270
HDDV5	0.086	0.018	0.019	0.123
HDDV6	0.745	0.089	0.093	0.927
HDDV7	1.081	0.129	0.135	1.344
HDDV8A	1.514	0.468	0.162	2.145
HDDV8B	5.723	1.638	0.569	7.929
HDGB	0.006	0.001	0.001	0.008
HDDBT	0.270	0.011	0.011	0.292
HDDBS	0.469	0.022	0.023	0.514
Total	16.329	9.880	12.692	38.901

6.2.3.2 Paved Road Fugitive Dust

The daily VMT for each road type within the micro-inventory domain was derived from the latest 2010 traffic assignment, as shown in Table VI-19. The Santan Freeway was completed in mid-2006 so daily VMT due to the traffic on the Santan Freeway are added to the freeway category.

Table VI-19. Daily VMT for each road type within the micro-inventory domain derived from the latest 2010 traffic assignment.

Road Type	Daily VMT (miles/day)
Centroid	46,860
Low volume arterial (AWDT < 10,000)	5,093
High volume arterial (AWDT >= 10,000)	231,805
Freeway	222,337

Average-day 2010 PM-10 emissions from paved road fugitive dust within the micro-inventory domain were derived by using the same calculation methods and emissions factors used for the base year emissions inventory, as shown below:

Daily PM-10 paved road fugitive dust emissions inside the micro-inventory domain (lbs/day)	= Daily VMT	× Emissions factor	× Conversion factor for average weekday to annual average daily traffic (0.91)

Annual average daily PM-10 emissions from paved road fugitive dust in the micro-inventory domain are listed in Table VI-20.

Table VI-20. 2010 annual average daily PM-10 emissions from paved road fugitive dust in the micro-inventory domain.

Road Type	Daily PM-10 (lbs/day)
Centroid	159.82
Low volume arterial (AWDT < 10,000)	17.37
High volume arterial (AWDT >= 10,000)	302.28
Freeway	80.29

6.2.3.3 Trackout

Average-day 2010 PM-10 trackout emissions from major arterials within the micro-inventory domain were derived by using the same calculation methods, emissions factors, and rule effectiveness used for the base year emissions inventory, as shown below:

Daily controlled PM-10 trackout emissions from each major arterial link inside the micro-inventory domain (lbs/day)	= Traffic count	× 100 ft	× Compliance rate (51%)	× Conversion factor from feet to mile (0.0001894)	× Number of trackout points	× Emissions factor	× Trackout factor	× Conversion factor for average weekday to annual average daily traffic (0.91)
	+ Traffic count	× 500 ft	× Non-compliance rate (49%)	× Conversion factor from feet to mile (0.0001894)	× Number of trackout points	× Emissions factor	× Trackout factor	× Conversion factor for average weekday to annual average daily traffic (0.91)

Daily controlled PM-10 trackout emissions from major arterials inside the micro-inventory domain (lbs/day)

$$= \sum_{\text{Arterial link}=1}^{25} \left(\text{Controlled trackout emissions for an arterial link} \right)$$

= 164.01 lbs/day

The 2010 vehicle counts for each arterial link, which is one of the major calculation factors above, were extrapolated from the actual 2006 vehicle counts (MAG, 2007) applying the gradient of the traffic assignment data for each major arterial from 2006 to 2010.

6.2.4 WINDBLOWN DUST

Average day PM-10 windblown dust emissions within the micro-inventory domain in 2010 are projected by using the area ratio of planned land use categories in the future year to the base year totals and applying an emissions reduction ratio of 26% for vacant land use, as shown in Table VI-21. The 26% reduction in 2010 is attributable to measures #8 and #30-33 in the Five Percent Plan.

Table VI-21. Windblown dust calculations for land use categories based on land use allocation factors (base year to future year) within the micro-inventory domain.

Land Use Category	Base Year Area in Micro-inventory Domain (acre)	Future Year Area in Micro-inventory Domain (acre)	Land use Allocation Factor (%)	Emissions reduction ratio (%)	Base Year PM-10 Emissions in Micro-inventory Domain (lbs/day)	Future Year PM-10 Emissions in Micro-inventory Domain (lbs/day)
Vacant	374	374	100.0	26	23.63	17.49
Residential Construction	947	452	47.7	0	39.93	19.05
Commercial Construction	72	11	15.3	0	2.10	0.32
Transportation Construction	230	0	0	0	1.05	0
Agricultural	680	0	0	0	0.63	0
Total					67.34	36.86

6.3 FUTURE YEAR (2010) EMISSIONS INVENTORY BASED ON COMMITTED CONTROL MEASURES WITHOUT LAND USE PROJECTION

A second future year emissions inventory was developed assuming that the same mix of sources existed in the modeling domain in 2010 as in 2006. The emissions reductions in 2010 for control measures in the Five Percent Plan are applied to this 2010 emissions inventory to show attainment. The emissions reductions from committed measures in the Five Percent Plan are documented in Chapter III of the TSD and Chapter Seven of the Plan.

6.3.1 CONSTRUCTION ACTIVITIES

In the Five Percent Plan, committed control measures # 2, 3, 8, 9, 10, 16, 36, 37, 38, and 44 were estimated to reduce about 48% of construction emissions by 2010 due to an increase in compliance with Rule 310 from 51% to 80%. By applying this reduction rate to the base year construction emissions, the future year construction emissions are projected as shown in Table VI-22. The calculations are shown in Chapter 6.2.1.

Table VI-22. Typical daily emissions from construction activities for the micro-inventory domain.

Project Type	Controlled base year daily emissions (lbs/day)	Controlled future year daily emissions (lbs/day)
Residential construction	630.77	326.47
Commercial construction	519.62	268.91
Road construction	2,534.04	1,311.54

6.3.2 NONROAD MOBILE SOURCES

Since no control measures were applied to nonroad mobile sources, PM-10 emissions for nonroad mobile sources remained the same amount as the base year emissions inventory. Table VI-23 shows the future year emissions from nonroad mobile sources.

Table VI-23. Typical daily emissions from nonroad mobile sources for the micro-inventory domain.

Nonroad Mobile Sources	Future year daily emissions (lbs/day)
Lawn and garden equipment	4.72
Locomotives	2.29
Agricultural equipment	0.37
Construction equipment	158.69
Commercial equipment	3.13

6.3.3 ONROAD MOBILE SOURCES

6.3.3.1 Vehicle Exhaust, Tire Wear, and Brake Wear

Average-day motor vehicle exhaust, tire wear, and brake wear emissions in the micro-inventory domain for 2010 were estimated using the MOBILE6.2 model with the same assumptions used for the base year emissions inventory, except the average diesel fuel sulfur level of 15 ppm. The total VMT of 506,095 miles/day for the micro-inventory domain in 2006 is applied to this calculation. The VMT mix and the emissions factors by vehicle class generated by MOBILE6.2 are listed in Table VI-24. Annual average daily PM-10 emissions from vehicle exhaust, tire wear, and brake wear by vehicle class in the micro-inventory domain are listed in Table VI-25.

Table VI-24. 2010 annual average daily VMT and emissions factors by vehicle class for the micro-inventory domain.

Vehicle type	VMT Mix	Emission Factor (g/mile)		
		PM-10 Ext	PM-10 Tire	PM-10 Brake
LDGV	0.4044	0.005	0.008	0.013
LDGT1	0.0756	0.005	0.008	0.013
LDGT2	0.2517	0.005	0.008	0.013
LDGT3	0.0887	0.005	0.008	0.013
LDGT4	0.0408	0.005	0.008	0.013
HDGV2B	0.0297	0.056	0.008	0.013
HDGV3	0.0010	0.057	0.012	0.013
HDGV4	0.0004	0.060	0.012	0.013
HDGV5	0.0012	0.056	0.012	0.013
HDGV6	0.0026	0.055	0.012	0.013
HDGV7	0.0011	0.056	0.012	0.013
HDGV8A	0.0000	0.057	0.036	0.013
HDGV8B	0.0000	0.000	0.000	0.000
MC	0.0049	0.021	0.004	0.013
LDDV	0.0006	0.158	0.008	0.013
LDDT12	0.0002	0.348	0.008	0.013
LDDT34	0.0019	0.092	0.008	0.013
HDDV2B	0.0094	0.122	0.008	0.013
HDDV3	0.0029	0.109	0.012	0.013
HDDV4	0.0031	0.114	0.012	0.013
HDDV5	0.0014	0.105	0.012	0.013
HDDV6	0.0072	0.218	0.012	0.013
HDDV7	0.0105	0.220	0.012	0.013
HDDV8A	0.0128	0.266	0.036	0.013
HDDV8B	0.0449	0.281	0.036	0.013
HDGB	0.0002	0.083	0.012	0.013
HDDBT	0.0009	0.662	0.012	0.013
HDDBS	0.0017	0.454	0.012	0.013

Table VI-25. 2010 annual average daily PM-10 emissions by vehicle class in the micro-inventory domain.

Vehicle type	Annual Average Daily PM-10 Emissions (lbs/day)			
	PM-10 Ext	PM-10 Tire	PM-10 Brake	PM-10 Total
LDGV	0.619	1.076	1.682	3.376
LDGT1	0.131	0.201	0.314	0.646
LDGT2	0.435	0.670	1.047	2.152
LDGT3	0.159	0.236	0.369	0.764
LDGT4	0.073	0.109	0.170	0.352
HDGV2B	0.557	0.079	0.123	0.760
HDGV3	0.019	0.004	0.004	0.027
HDGV4	0.008	0.002	0.002	0.011
HDGV5	0.022	0.005	0.005	0.032
HDGV6	0.048	0.010	0.011	0.069
HDGV7	0.020	0.004	0.005	0.029
HDGV8A	0.000	0.000	0.000	0.000
HDGV8B	0.000	0.000	0.000	0.000
MC	0.034	0.007	0.020	0.060
LDDV	0.032	0.002	0.002	0.036
LDDT12	0.023	0.001	0.001	0.024
LDDT34	0.058	0.005	0.008	0.071
HDDV2B	0.383	0.025	0.039	0.447
HDDV3	0.105	0.012	0.012	0.129
HDDV4	0.117	0.012	0.013	0.142
HDDV5	0.049	0.006	0.006	0.060
HDDV6	0.521	0.029	0.030	0.580
HDDV7	0.767	0.042	0.044	0.853
HDDV8A	1.134	0.153	0.053	1.340
HDDV8B	4.194	0.538	0.187	4.918
HDGB	0.005	0.001	0.001	0.007
HDDBT	0.198	0.004	0.004	0.206
HDDBS	0.257	0.007	0.007	0.270
Total	9.969	3.237	4.157	17.363

6.3.3.2 Paved Road Fugitive Dust

The same daily VMT used for the base year emissions inventory was applied to calculate the paved road fugitive dust. Average-day 2010 PM-10 emissions from paved road fugitive dust within the micro-inventory domain were derived by using the same calculation methods and emissions factors used for the base year emissions inventory, as shown below:

Daily controlled PM-10 paved road fugitive dust emissions inside the micro-inventory domain (lbs/day)	= Daily VMT	× Emissions factor	× Conversion factor for average weekday to annual average daily traffic (0.91)

Annual average daily PM-10 emissions from paved road fugitive dust in the micro-inventory domain are listed in Table VI-26.

Table VI-26. 2010 annual average daily PM-10 emissions from paved road fugitive dust in the micro-inventory domain.

Road Type	Daily controlled PM-10 (lbs/day)
Centroid	81.16
Low volume arterial (AWDT < 10,000)	139.44
High volume arterial (AWDT >= 10,000)	131.83
Freeway	0

6.3.3.3 Trackout

Daily controlled PM-10 trackout emissions from major arterials inside the micro-inventory domain were derived by applying the same data and methodology used for the base year emissions inventory.

$$\text{Daily controlled PM-10 trackout emissions from major arterials inside the micro-inventory domain (lbs/day)} = \sum_{\text{arterial link}=1}^{24} \left(\text{Controlled trackout emission for an arterial link} \right)$$

$$= 198.11 \text{ lbs/day}$$

6.3.4 AGRICULTURAL ACTIVITIES

Since no control measures were applied to agricultural activities, PM-10 emissions for agricultural activities remained the same amount as the base year emissions inventory. Table VI-27 shows the future year emissions from agricultural activities.

Table VI-27. Typical daily emissions from agricultural activities for the micro-inventory domain.

Agricultural Activities	Future year daily emissions (lbs/day)
Tilling	44.15
Harvesting	5.10
Unpaved agricultural road	42.27

6.3.5 WINDBLOWN DUST

Committed control measures were estimated to reduce PM-10 emissions for windblown dust for vacant areas by 26%. The 26% reduction in 2010 is based on the implementation of committed measures #8 and #30-33 shown in Table 7-1 of the Five Percent Plan. Table VI-28 shows the future year emissions applying the emissions reduction rate above.

Table VI-28. Typical daily emissions from windblown dust for the micro-inventory domain.

Land Use Category	Base year daily emissions (lbs/day)	Future year daily emissions (lbs/day)
Vacant	23.63	17.49
Residential construction	39.93	39.93
Commercial construction	2.10	2.10
Transportation construction	1.05	1.05
Agricultural	0.63	0.63

7. ATTAINMENT DEMONSTRATION

7.1 BACKGROUND CONCENTRATIONS

To determine the appropriate background PM-10 concentrations around the Higley monitor, air quality and meteorological data was evaluated by T&B Systems. The analysis concluded the background PM-10 concentration was estimated to be 30 $\mu g/m^3$ on the design date of January 24, 2006. See Appendix VI, Exhibit 1.

7.2 EMISSIONS INVENTORY SUMMARY

The base year PM-10 emissions inventory for sources within the micro-inventory domain is presented in Table VI-29. More than three-quarters (80 percent) of the emissions were generated from construction activities. Road construction on the Santan Freeway (Loop 202) was the single largest contributor to the base year PM-10 emissions inventory within the micro-inventory domain. The next two highest categories were residential construction and commercial construction. All other source categories contributed less than 10 percent to the base year PM-10 emissions inventory.

Table VI-29. PM-10 emissions inventory surrounding the Higley monitoring station in 2006.

Source Category	Emissions (lbs/day)	Percent Contribution (%)
Construction	**3,684.43**	**80.43**
Residential Construction	630.77	13.77
Commercial Construction	519.62	11.34
Road Construction	2,534.04	55.32
Onroad Mobile Sources	**568.57**	**12.41**
Vehicle Exhaust, Tire Wear, and Brake Wear	18.03	0.39
Paved Road Fugitive Dust	352.43	7.69
Trackout	198.11	4.32
Nonroad Mobile Sources	**169.20**	**3.69**
Lawn and Garden Equipment	4.72	0.10
Locomotives	2.29	0.05
Agricultural Equipment	0.37	0.01
Construction Equipment	158.69	3.46
Commercial Equipment	3.13	0.07
Agricultural Activities	**91.52**	**2.00**
Tilling	44.15	0.96
Harvesting	5.10	0.11
Travel on Unpaved Agricultural Roads	42.27	0.92
Windblown Dust	**67.34**	**1.47**
Total	**4,581.06**	

By following the numbered grid structure presented in Figure VI-12, the sources within the micro-inventory domain were distributed to each grid square as shown in Table VI-30 and Figure VI-15. The distribution of emissions throughout the micro-inventory domain is skewed toward the north and west of the monitoring station, where mainly road construction was conducted. Especially, grid cell 19 including all three major contributors, such as residential/road construction activities and onroad mobile sources, resulted in the most significant contributor to the base year PM-10 emissions inventory in the micro-inventory domain. Among the ½ kilometer squares within a one-kilometer radius, all grid cells were dominated by emissions from residential construction activities and onroad mobile sources.

Table VI-30. PM-10 emissions inventory by grid squares surrounding the Higley monitoring station in 2006.

Grid Square Number	Emissions (lbs/day)	Percent Contribution (%)
1	47.01	1.03
2	102.78	2.24
3	80.32	1.75
4	47.11	1.03
5	12.09	0.26
6	218.20	4.76
7	155.77	3.40
8	45.44	0.99
9	16.27	0.36
10	13.51	0.29
11	30.16	0.66
12	9.34	0.20
13	37.14	0.81
14	9.40	0.21
15	13.28	0.29
16	16.22	0.35
17	375.25	8.19
18	544.75	11.89
19	580.40	12.67
20	341.50	7.45
21	496.72	10.84
22	65.09	1.42
23	531.26	11.60
24	53.81	1.17
25	474.17	10.35
26	47.29	1.03
27	61.68	1.35
28	155.08	3.39

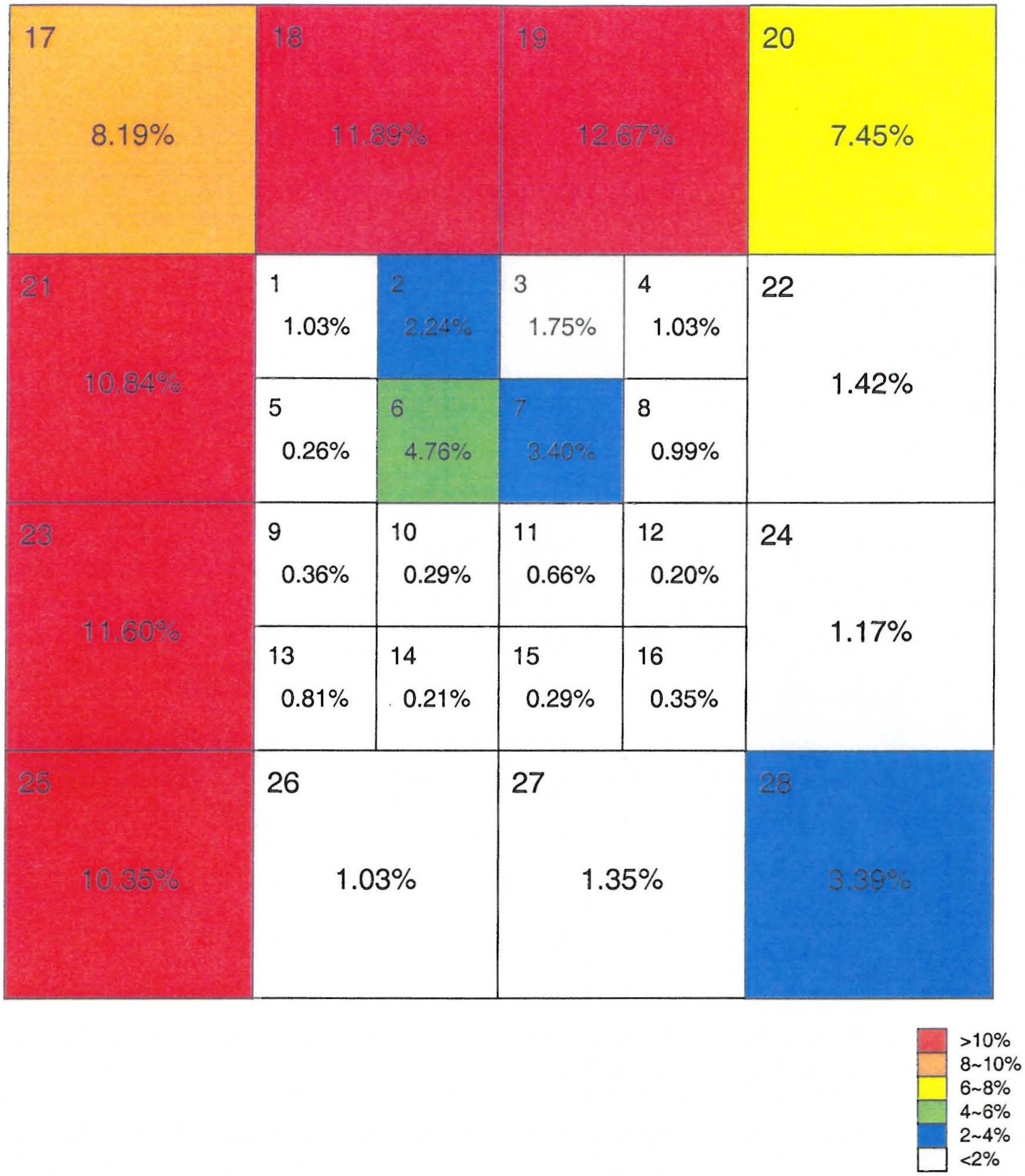

Figure VI-15. Percent contribution of daily total PM-10 emissions by grid in 2006.

The future year PM-10 emissions inventory applying land use projections with committed control measures in the Five Percent Plan within the micro-inventory domain is presented in Table VI-31. Since the Santan Freeway construction and most residential construction activities are completed by 2010, major emissions sources were predicted to move to onroad mobile sources. Paved road fugitive dust was estimated as the single largest contributor to the future year PM-10 emissions inventory within the micro-inventory domain. In contrast with the base year emissions distribution, onroad mobile sources were estimated to dominate the future year PM-10 emissions sources, at about 71 percent of the total inventory. The next highest category is residential construction activities. All other source categories contributed less than 10 percent to the future year PM-10 emissions inventory.

Table VI-31. Future year PM-10 emissions inventory applying land use projections with committed control measures within the micro-inventory domain.

Source Category	Emissions (lbs/day)	Percent Contribution (%)
Construction	**197.05**	**18.39**
Residential Construction	155.77	14.54
Commercial Construction	41.28	3.85
Road Construction	0.00	0.00
Onroad Mobile Sources	**762.67**	**71.17**
Vehicle Exhaust, Tire Wear, and Brake Wear	38.90	3.63
Paved Road Fugitive Dust	559.76	52.23
Trackout	164.01	15.30
Nonroad Mobile Sources	**75.04**	**7.00**
Lawn and Garden Equipment	8.46	0.79
Locomotives	2.29	0.21
Agricultural Equipment	0.00	0.00
Construction Equipment	58.54	5.46
Commercial Equipment	5.75	0.54
Agricultural Activities	**0.00**	**0.00**
Tilling	0.00	0.00
Harvesting	0.00	0.00
Travel on Unpaved Agricultural Roads	0.00	0.00
Windblown Dust	**36.86**	**3.44**
Total	**1,071.62**	

The distribution of the future year PM-10 emissions sources applying land use projections with committed control measures within the micro-inventory domain to each grid square is shown in Table VI-32 and Figure VI-16. Emissions appear to be fairly evenly distributed throughout the micro-inventory domain. Grid cells 22 and 24 including residential construction activities and onroad mobile sources have higher emissions contributions to the future year PM-10 emissions inventory in the micro-inventory domain. Within a one-kilometer radius from the monitoring site, all grid cells were dominated by emissions from onroad mobile sources.

Table VI-32. Future year PM-10 emissions inventory by square applying land use projections with committed control measures within the micro-inventory domain.

Grid Square Number	Emissions (lbs/day)	Percent Contribution (%)
1	12.29	1.15
2	12.30	1.15
3	12.85	1.20
4	16.13	1.50
5	11.89	1.11
6	4.44	0.41
7	13.50	1.26
8	21.06	1.96
9	8.00	0.75
10	9.56	0.89
11	5.76	0.54
12	40.91	3.82
13	11.86	1.11
14	9.93	0.93
15	13.91	1.30
16	14.00	1.31
17	55.51	5.18
18	85.37	7.97
19	54.12	5.05
20	64.93	6.06
21	67.29	6.28
22	120.06	11.20
23	32.60	3.04
24	166.87	15.57
25	26.69	2.49
26	28.20	2.63
27	53.63	5.00
28	97.97	9.14

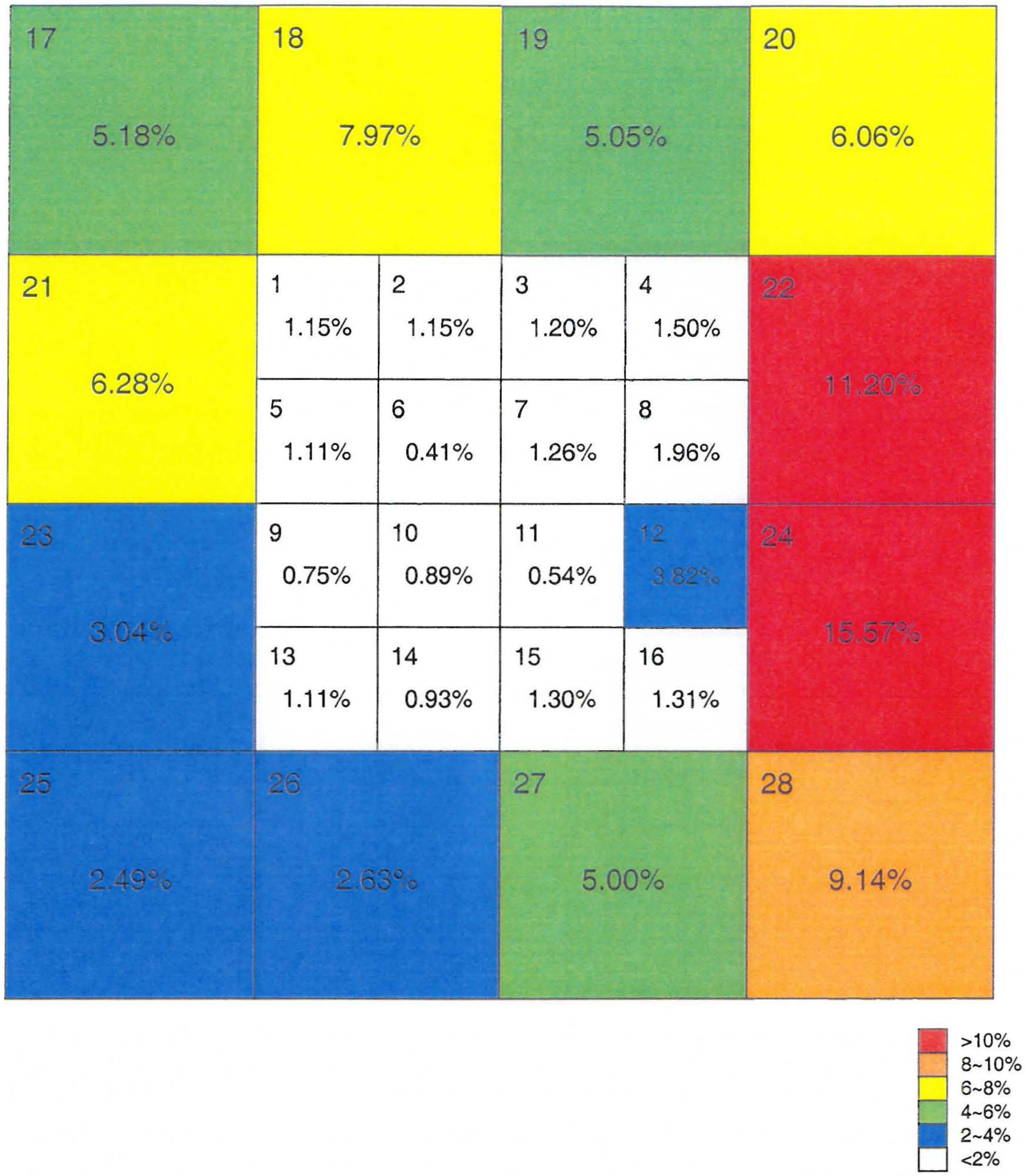

Figure VI-16. Percent contribution of daily total PM-10 emissions by grid applying land use projections with committed control measures in 2010.

The future year PM-10 emissions inventory for control measures committed in the Five Percent Plan without land use projection within the micro-inventory domain is presented in Table VI-33. Since, in this scenario, major construction activities, including the Santan Freeway construction, are assumed to be ongoing, construction activities were predicted as the major emissions sources. Road construction was estimated as the single largest contributor to the future year PM-10 emissions inventory within the micro-inventory domain. Similar to the base year PM-10 emissions distribution, construction activities were estimated to dominate the future year PM-10 emissions sources, with about 68 percent of the total emissions inventory. The next highest category is onroad mobile sources. All other source categories contributed less than 10 percent to the future year PM-10 emissions inventory.

Table VI-33. Future year PM-10 emissions inventory applying committed control measures without land use projections within the micro-inventory domain.

Source Category	Emissions (lbs/day)	Percent Contribution (%)
Construction	**1,906.92**	**68.18**
Residential Construction	326.47	11.67
Commercial Construction	268.91	9.62
Road Construction	1,311.54	46.90
Onroad Mobile Sources	**567.90**	**20.31**
Vehicle Exhaust, Tire Wear, and Brake Wear	16.50	0.62
Paved Road Fugitive Dust	352.43	12.60
Trackout	198.11	7.08
Nonroad Mobile Sources	**169.20**	**6.05**
Lawn and Garden Equipment	4.48	0.17
Locomotives	2.29	0.08
Agricultural Equipment	0.35	0.01
Construction Equipment	145.99	5.67
Commercial Equipment	2.97	0.11
Agricultural Activities	**91.52**	**3.27**
Tilling	36.64	1.58
Harvesting	4.23	0.18
Travel on Unpaved Agricultural Roads	34.66	1.51
Windblown Dust	**61.20**	**2.19**
Total	**2,796.74**	

The distribution of the future year PM-10 emissions sources applying committed control measures without land use projection within the micro-inventory domain to each grid square is shown in Table VI-34 and Figure VI-17. Similar to the base year, the distribution of emissions throughout the micro-inventory domain is skewed toward the north and west of the monitoring station, where road construction activities are dominant. Especially, grid cell 19 including all three major PM-10 emissions sources, such as residential/road construction activities and onroad mobile sources, still was the most significant contributor to the future year PM-10 emissions inventory in the micro-inventory domain. Among the ½ kilometer squares within a one-kilometer radius, all grid cells were dominated by emissions from residential construction activities and onroad mobile sources.

Table VI-34. Future year PM-10 emissions inventory by square applying committed control measures without land use projections within the micro-inventory domain.

Grid Square Number	Emissions (lbs/day)	Percent Contribution (%)
1	31.77	1.14
2	58.09	2.08
3	55.85	2.00
4	30.38	1.09
5	11.65	0.42
6	117.25	4.19
7	95.52	3.42
8	28.80	1.03
9	13.99	0.50
10	13.42	0.48
11	25.96	0.93
12	9.28	0.33
13	24.20	0.87
14	9.32	0.33
15	13.05	0.47
16	14.52	0.52
17	216.84	7.75
18	317.25	11.34
19	346.13	12.38
20	215.55	7.71
21	278.85	9.97
22	56.24	2.01
23	294.65	10.54
24	49.94	1.79
25	258.14	9.23
26	38.11	1.36
27	57.61	2.06
28	114.36	4.09

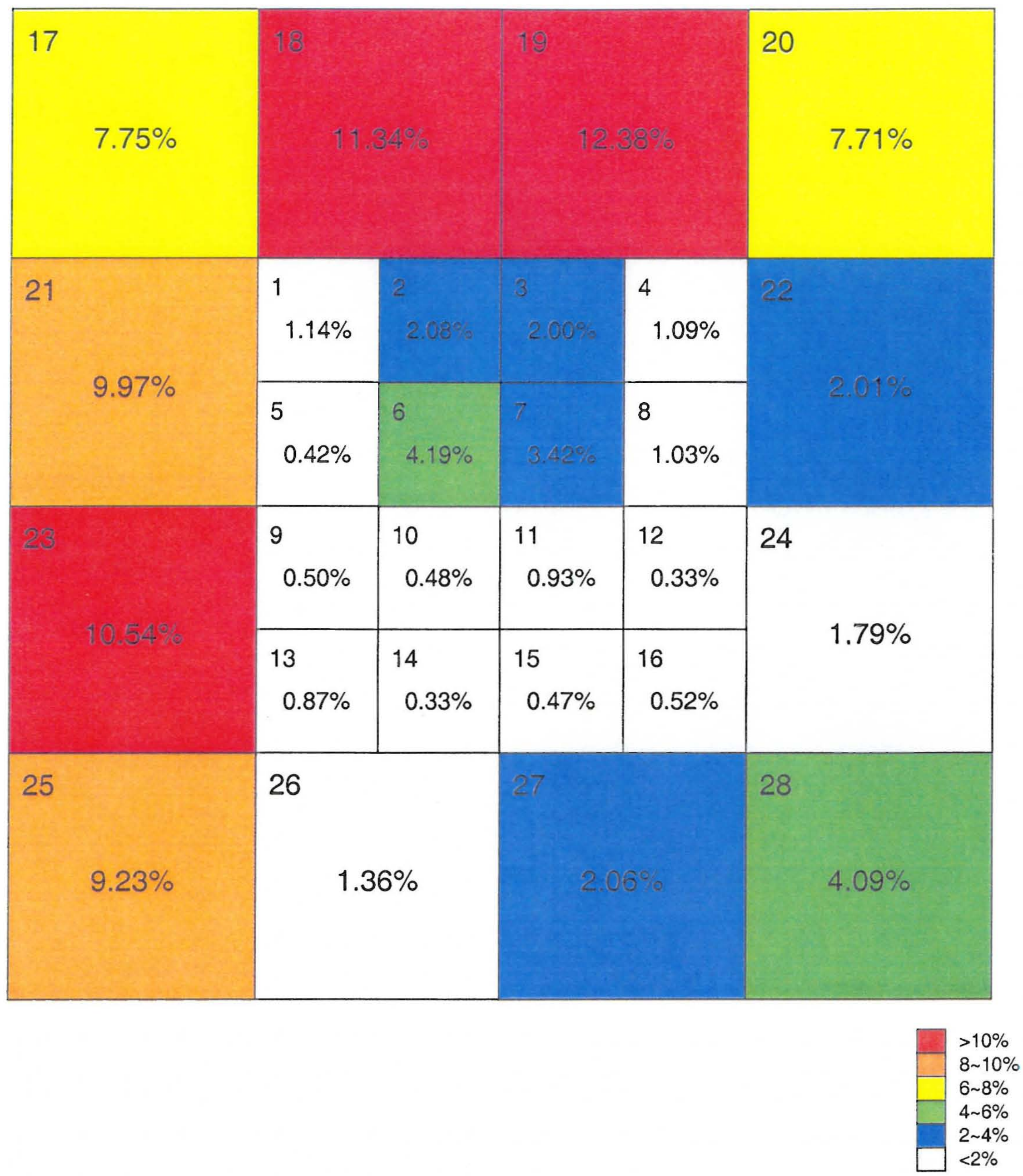

Figure VI-17. Percent contribution of daily total PM-10 emissions by grid without land use projections in 2010.

7.3 ATTAINMENT DEMONSTRATION BASED ON LAND USE PROJECTION WITH COMMITTED CONTROL MEASURES

According to the relative reduction of PM-10 emissions above, a future-to-base year emission ratio of 0.2339, which is dominated by a significant reduction in construction activities, was applied to estimate the highest PM-10 concentration in the future year. As presented in Table VI-35, the summary for the future year based on the emissions inventory applying the land use projection shows attainment for the 24-hour PM-10 standard at the Higley monitoring station with the highest concentration of 63 μg/m^3 for PM-10.

Table VI-35. Summary of attainment demonstration for the future year (2010) based on the projected future year emissions inventory.

	Base Year	Future to Base Ratio	Future Year
Highest PM-10 Conc.	170 μg/m^3		63 μg/m^3
Background PM-10 Conc.	30 μg/m^3		30 μg/m^3
PM-10 Conc. Difference	140 μg/m^3	0.2339	33 μg/m^3
Total Emissions	4,581.06 lbs/day		1,071.62 lbs/day

7.4 ATTAINMENT DEMONSTRATION BASED ON COMMITTED CONTROL MEASURES WITHOUT LAND USE PROJECTION

As an alternative scenario, another attainment demonstration for the future year was performed by applying control measures in the Five Percent Plan to the existing base year emissions inventory without any land use projection, as shown in Table VI-36. This shows the impact of committed control measures within the micro-inventory domain if land uses did not change between 2006 and 2010. In this scenario, the background concentration still remains constant. This scenario also shows attainment for the 24-hour PM-10 standard at the Higley monitoring station with the highest concentration of 115 μg/m^3 for PM-10.

Table VI-36. Summary of attainment demonstration for the future year (2010) based on the controlled base year emissions inventory.

	Base Year	Future to Base Ratio	Future Year
Highest PM-10 Conc.	170 μg/m^3		115 μg/m^3
Background PM-10 Conc.	30 μg/m^3		30 μg/m^3
PM-10 Conc. Difference	140 μg/m^3	0.6105	85 μg/m^3
Total Emissions	4,581.06 lbs/day		2,796.74 lbs/day

8. CONCLUSIONS

The proportional rollback model was applied to the micro-inventory domain surrounding the Higley monitoring station to demonstrate 24-hour PM-10 attainment at the site in 2010. Two attainment demonstrations were performed based on three sets of PM-10 emissions inventories for the micro-scale domain. One of the emissions inventories is for the base year (2006) and the other emissions inventories are for the future year (2010) with and without land use projections. Both projections assume additional control measures committed in the Five Percent Plan. Both of the demonstrations show attainment for the 24-hour PM-10 standard at the Higley monitoring station in the future year. The attainment demonstration based on the emissions inventory using the future year land use projections shows attainment with a PM-10 concentration of 63 $\mu g/m^3$. The attainment demonstration based on the emissions inventory without land use projections shows attainment with maximum 24-hour PM-10 concentration of 115 $\mu g/m^3$. While changes in land use are the most effective factor in demonstrating attainment at the Higley monitoring station in 2010, the scenario without changes in land use indicates that the control measures in the Five Percent Plan will result in attainment in 2010 at other sites in the nonattainment area which have a similar mix of construction sources as Higley in 2006.

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